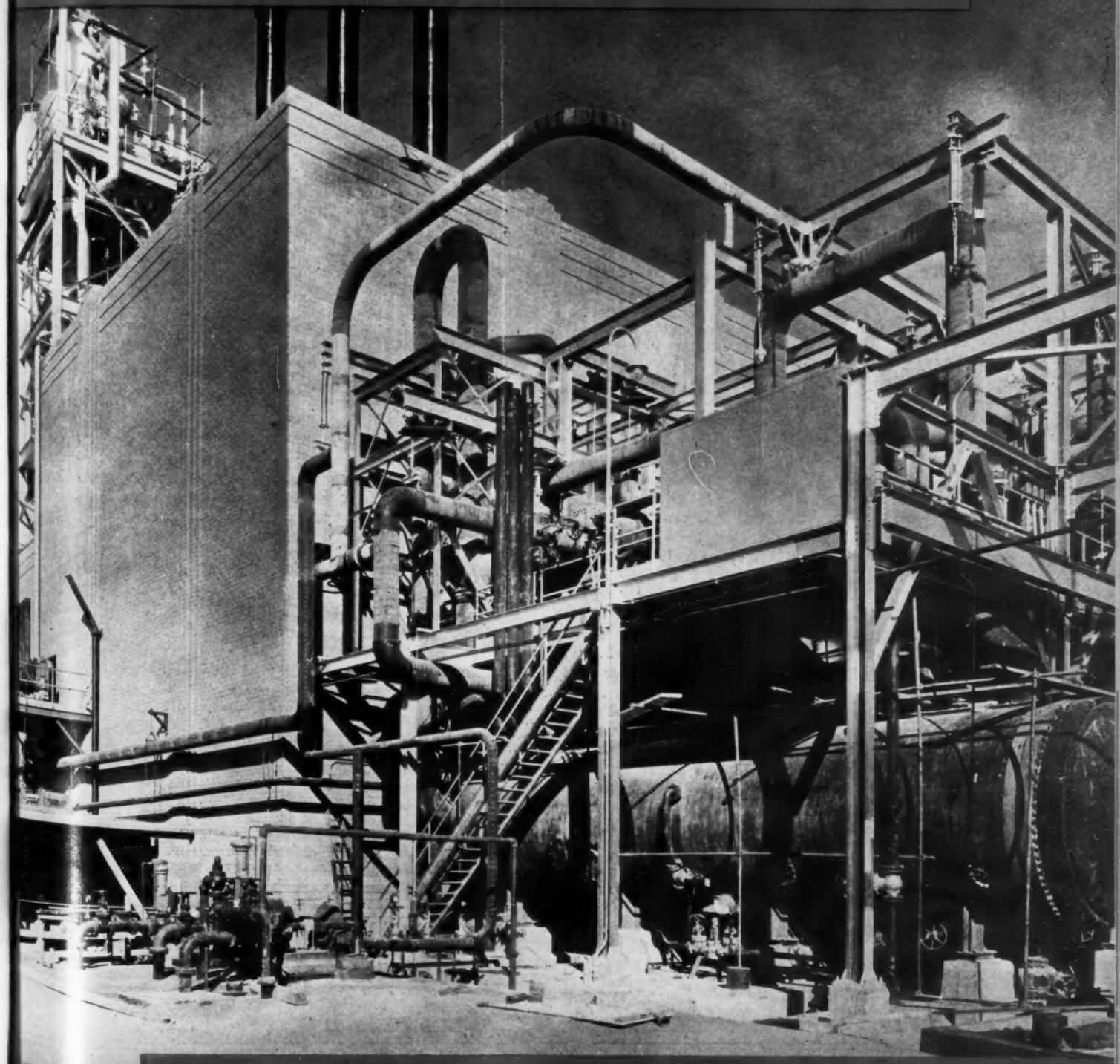
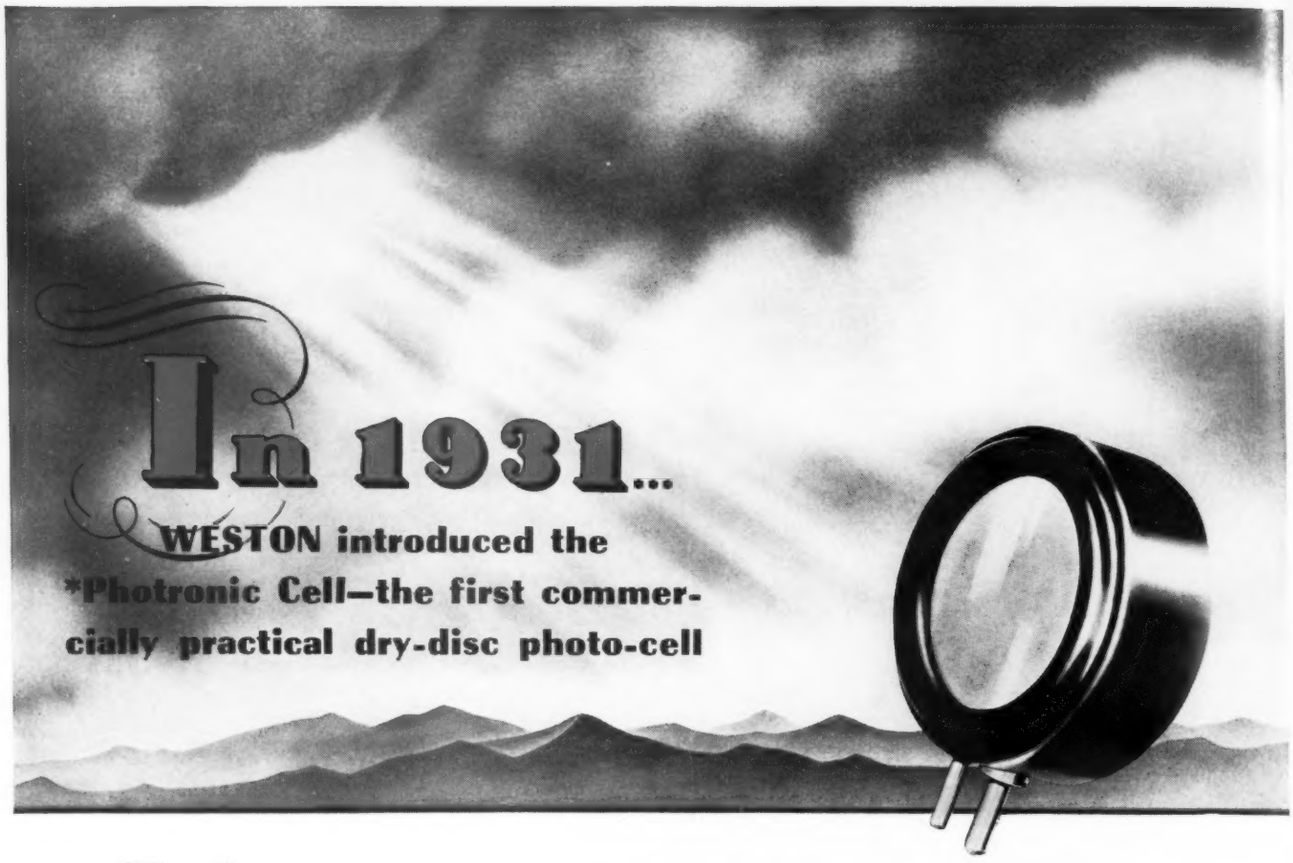
# Electrical World

JUNE 28, 1941



MULTIPLE-SERVICE PLANT HAS SEMI-OUTDOOR CONSTRUCTION

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# HAZARD INSULATED WIRES AND CABLES

# In Spite of All That

For years we have maintained with all of our force that there would be no power shortage, at least so far as utility responsibility for capacity was concerned. We still believe we were right, although situations beyond the control of utilities, such as a strike in a supplier's factory or a drought, may bring some problems.

Nevertheless, being right may bring about as much consolation to the utilities as to the man whose tombstone read,

> "Here lies the body of William Gray,
> He died of having the right of way."

If this war continues for years and if the program for munitions expenditures keeps on mounting in a race to produce much more than the Axis, then more power will be needed and preparations must be made now. Already deliveries on large steam units are over two years, so that anything to be ready for 1943 peak must be ordered within the next few weeks.

The point is that the whole preparedness effort has reached a place where reason no longer is the pilot. What does it cost? How will we pay for it? What will we do with it after the war? These are guiding principles in any sound peace-time economy, but now they seem to have about as much weight as a feather with those who are managing the program.

This is the supreme gamble in which everything is at stake. If the struggle lasts for as long a time as those close to the President believe, then perhaps it is pointless to be paying a great deal of attention now to questions of financial prudence since a new set of rules will of necessity be in force at settlement time. Return on investment, protection of investors, and similar peace-time business rules will be of less and less consequence as this thing is continued.

It would be poor policy for the utilities to permit a situation to arise where for want of orders turbine or boiler manufacturing space were used for any other purpose, because if later more turbine capacity were needed there would be insufficient space to produce it.

Nor should it be forgotten that the Federal Power Commission has authority to order additions to capacity through interconnection or otherwise. This power is now being exercised and will be used more extensively unless it secures the co-operation it has requested.

Furthermore, no greater disaster could come to the utility industry, and there have been some bad ones in the past several years, than to have essential munitions production handicapped for want of sufficient generating capacity that was the responsibility of utilities to provide.

And that leads to one more point which must not be disregarded, and that is the ever-present threat of extension of government-built power. If the FPC says that power will be short in any region, no matter by what method the figures are arrived at, and the utilities stand on the position that there is enough capacity, it won't take much effort to get Congress to appropriate money for more government plants —steam as well as hydro. Not only that but OPM will back up FPC.

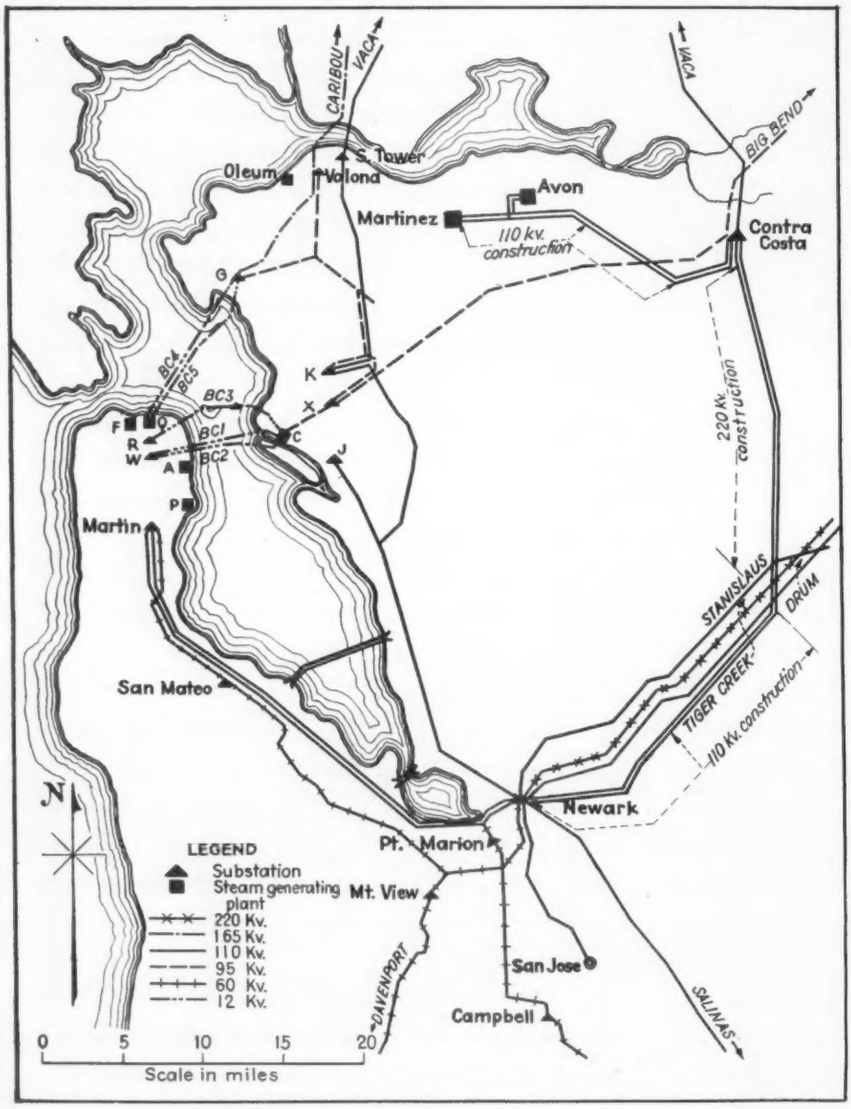
Perhaps this kind of thinking has arisen in the minds of a number of utility executives because word has come that in the first three weeks in June several orders for utility turbines were placed totaling several hundred thousand kilowatts. Inquiries have increased to a far greater degree.

Any one who has any question in his mind as to whether he may or may not need the additional capacity should order now. Today's motto is "When in doubt—buy."

# Multiple-Service Oil Refinery and Utility Generating Plants—I

***160,000 kw. in three stations to provide power and steam for oil refineries and capacity and energy for P.G.&E. system — Plants feature outdoor construction, high pressures and temperatures and ability to burn multiple fuels***

ECONOMICAL co-ordination of facilities beneficial to both operating utility and co-operating oil company characterizes the three steam plants being constructed by Pacific Gas & Electric Company adjacent to the refineries of the Tide Water Associated Oil Company, Shell Oil Company and Union Oil Company on the shores of San Francisco Bay. Of particular advantage to the oil companies is the assurance of an adequate and closely regulated electric supply for their refinery operations and steam up to a maximum demand of 875,000 lb. per hour, plus the disposal of waste products such as acid sludge, pitch and petroleum coke which are utilized by the power company as fuel in part payment for its services. The electric energy generated incidental to the production of steam and over and above the demands of the refineries, as well as the fuel arrangement, makes the plants important economical additions to the Pacific generating facilities.




**MAP of the San Francisco Bay area showing location of Avon, Martinez and Oleum steam plants**

The stations—located at Avon to serve Associated, Martinez to serve Shell and Oleum to serve Union—incorporate several new and unique features such as two distinct steam-operating cycles, semi-outdoor construction, ability to burn multiple fuels either singly or in combinations, earthquake resistant construction, flexible design and turbines equipped with a combination of speed and automatic extraction governing. Initially the 40,000-kw. plants were designed to be identical in major details, thus greatly reducing engineering, construction and operating costs. Recently however, power demands have necessitated the addition of a second unit to the Oleum plant. Otherwise the only differences are in circulating water supply, foundation conditions and a few minor items. The Avon plant has been operating since December 16, 1940; Martinez is scheduled to be placed in initial operation June 1, 1941; the first unit at Oleum will begin operating about

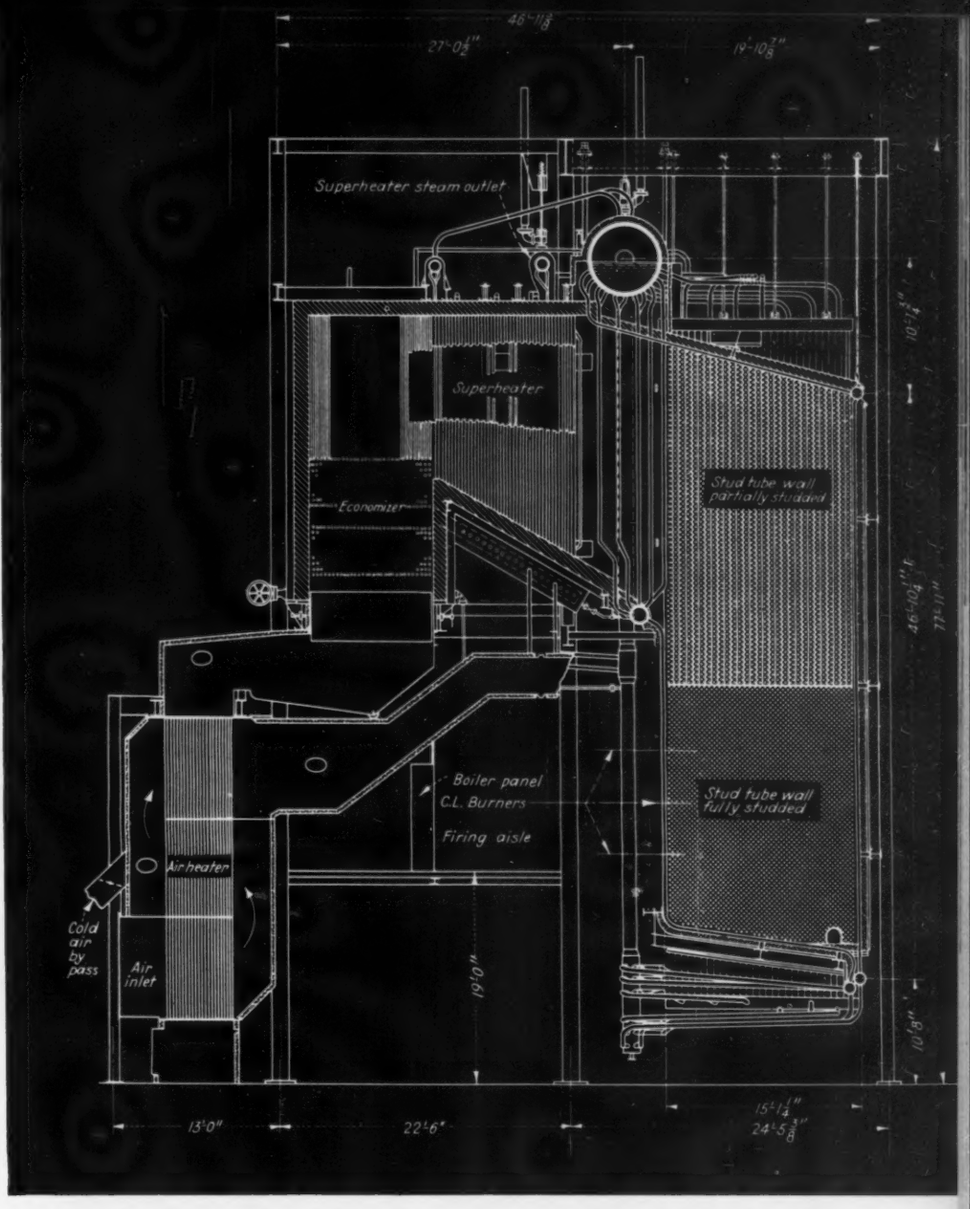
August 1, 1941, and the second unit approximately July 1, 1943. Exclusive of the twin-circuit 110-kv. transmission lines that will connect them to the Contra Costa and Newark substations, the plants will represent an investment of $20,000,000.

Idea for the dual function of the plants came out of joint investigations conducted by the company and the oil refineries in 1938. Faced with an increased demand for steam and power, together with the desire to increase operating efficiencies, the refineries conducted a study of the question of whether to purchase these services or build their own plants to supply them. It was found that the studies were in favor of purchased services and hence identical contracts, approved by the California Railroad Commission, were entered into between each company and Pacific Gas & Electric. The approximate quantities of steam and power required by the three refineries are 20,000 kw. maximum power demand, 120,000,000 kw.-hr. per year, 875,000 lb. per hour maximum steam demand and 4,000,000,000 lb. steam per year. The power is delivered at 2,300 volts and the steam at 160 lb. per sq.in. with 50 deg. F. superheat.

### *Boilers Outdoors*

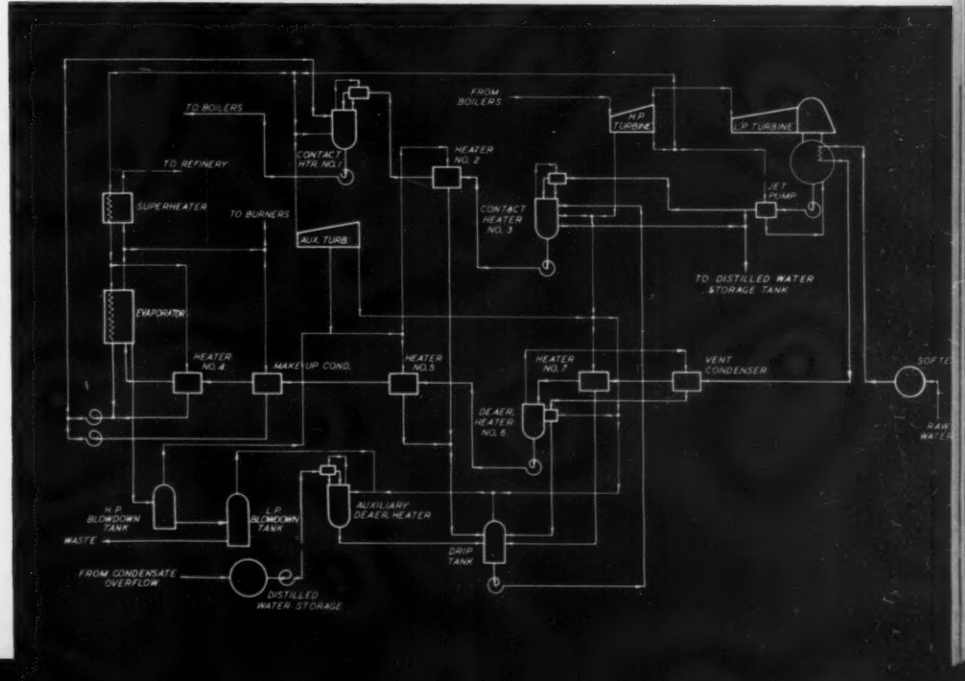
Because of the similarity of the stations, this description will be confined to the Avon plant, with notations as to the essential differences between the three stations. Arrangement of the plant is unconventional. Turbines, switch house and control room are housed in a brick building. Boilers, evaporators, fans, water-softening equipment, condensers and contact and deaerating heaters are constructed for outdoor operation. The hot-air duct between the air heater and the boiler front forms a roof over the firing aisle, and by roofing over corresponding space between boilers an inclosed firing aisle is obtained. All panels necessary for operation of individual units are located in the control room so that operation of the entire plant is centered at one point. Automatic equipment is installed wherever possible so that operating personnel is reduced to a minimum.

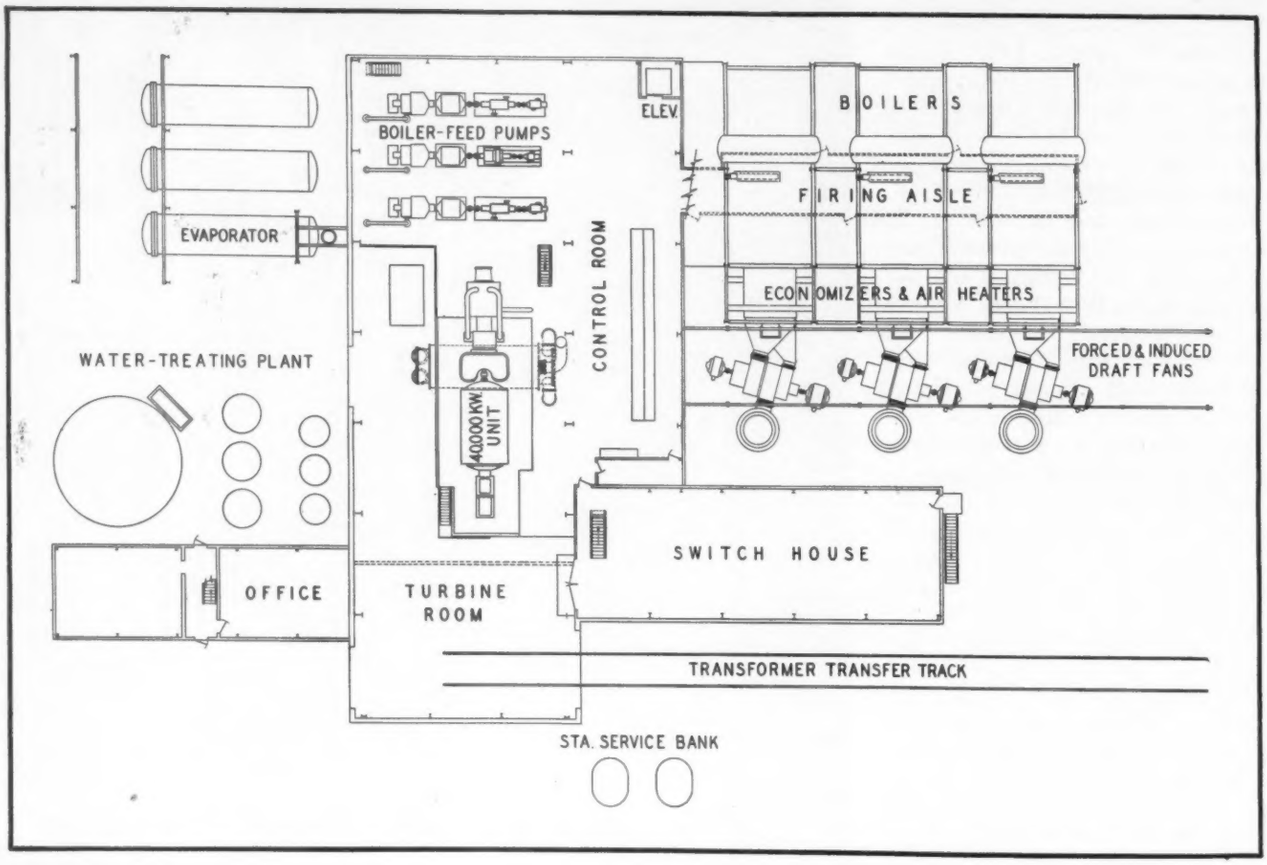
Design allows for any changes that might be dictated by future conditions. Should oil refining processes change so that steam would no longer




**CROSS-SECTION** of radiant type, 950-deg., 1,525-lb.-per-sq.in. boiler. Three are installed at Avon and Martinez and six at Oleum, although flexible planning will permit additional units to be added as future conditions dictate

**HEAT FLOW** diagram showing the two distinct steam operating cycles—(1) for power generation and (2) for evaporation for refinery steam






**PLAN of Avon Plant**

be required, the plants could be operated full condensing. On the other hand, should more steam be required, additional boiler, turbine and evaporator capacity can be added.

Three radiant type boilers (six at Oleum) are installed. These units reflect the most recent progress in design and obtain the "radiant" designation because all the boiling or addition of latent heat is accomplished by the radiation of heat to the furnace walls. There is no conventional boiler convection bank as the tubes between the furnace and the superheater are risers from a portion of the furnace waterwalls. Of the various types of units available, the radiant boiler also satisfactorily and economically met the requirements in steam output, steam pressure, total steam temperature and superheat control. At the same time they were capable of handling efficiently the multiplicity of fuels available. Total steam temperature is 940 deg. F., which is among the highest in commercial use, and pressure is 1,525 lb. per sq.in. The units have a maximum continuous capacity of 200,000 lb. steam per hour each and a 24-hour overload capacity of 230,000 lb. per hour. The boilers are equipped with the latest design cyclone separators, which, along with a steam scrubber, assures steam of the highest quality and purity. At the same time it permits wider fluctuations in water level without affecting steam quality and promotes better circulation in the boiler by insuring that steam-free water enters the downcomers.

### *Multiple Fuel*

The furnaces can be fired by natural gas, oil or acid sludge through three combination burners arranged in a vertical row. Possible future firing with pulverized petroleum coke has also been provided for by allowing space for pulverizers and piping to the burners. More than one of the fuels can be used simultaneously. For instance, when burning sludges, natural gas can be burned to support combustion and light the burners should some incombustibles be pumped to them. The fuels to be burned have so little ash that it was possible to design the furnaces with much simpler bottoms than would have been the case had it been necessary to provide for ash removal.

Boiler design allows just sufficient heating surface ahead of the superheaters to give them proper protection. Superheat temperature is kept down to 940 deg. F. at top loads by means of a gas by-pass along one side of the superheater. Automatic controls connected to dampers located in the gas stream behind the economizers control the superheat temperature. Quicker and safer starting up of the units has been obtained by by-passing the superheaters to prevent overheating of the elements during the time no steam is being generated.

Economizers are conventional horizontal water-tubular units with gas flowing down across the tubes and the water entering at the bottom and flowing up through the tubes. This design permits steam at high loads. Tubular air heaters have been lo-

**Suppliers of Major Steam-End Equipment**

| Equipment | Manufacturer |
|---|---|
| Boilers | Babcock & Wilcox |
| Turbines | General Electric |
| Condensers | Ingersoll-Rand & Worthington |
| Boiler feed pumps | Ingersoll-Rand & Worthington |
| Evaporators | Foster Wheeler |
| Cooling tower | Foster Wheeler |
| Boiler fans | Sturtevant |
| Stacks | Western Pipe & Steel |

cated back of and below the economizers to permit washing the economizers if necessary and to provide better operating room between the air heaters and the burners.

### *Condensing Arrangement*

Condensing equipment has been designed to condense 300,000 lb. of steam per hour with a heat surrender of 280,000,000 B.t.u. per hour, giving a back pressure of 1.89 in. of mercury abs. when 37,500 g.p.m. of water is circulated at 70 deg. F. Water flow is single pass and the water boxes and covers are divided so that half the tubes may be cleaned while the other half are in service.

Under certain conditions the unit will operate on standby service. At such times condensation of 15,000 lb. of steam per hour and surrender of 15,000,000 B.t.u. will serve to heat 300,000 lb. of evaporator feedwater from 60 to 110 deg. F. at a pressure of 3 in. of mercury abs. Heating of this water is effected in a four-pass heater located in the same shell but above the tubes of the main condenser. Between the heater and the main tube bank beneath is a diaphragm of shutter type at about 45 deg. on each side of the condenser, consisting of overlapping stainless-steel plates mounted upon shafts extending lengthwise of the shell parallel to but not coinciding with the center line of the plates. This is counterbalanced to remain in closed position, separating the heater or standby section of the shell from the main or load-operation section during the usual stand-by operation until opened by predetermined pressure difference, thermostatic or load control, or combination of controls.

Cooling is accomplished at Avon and Martinez with water that passes through a forced draft cooling tower. At Oleum the cooling water will be pumped directly from San Francisco Bay.

### *Two Distinct Cycles*

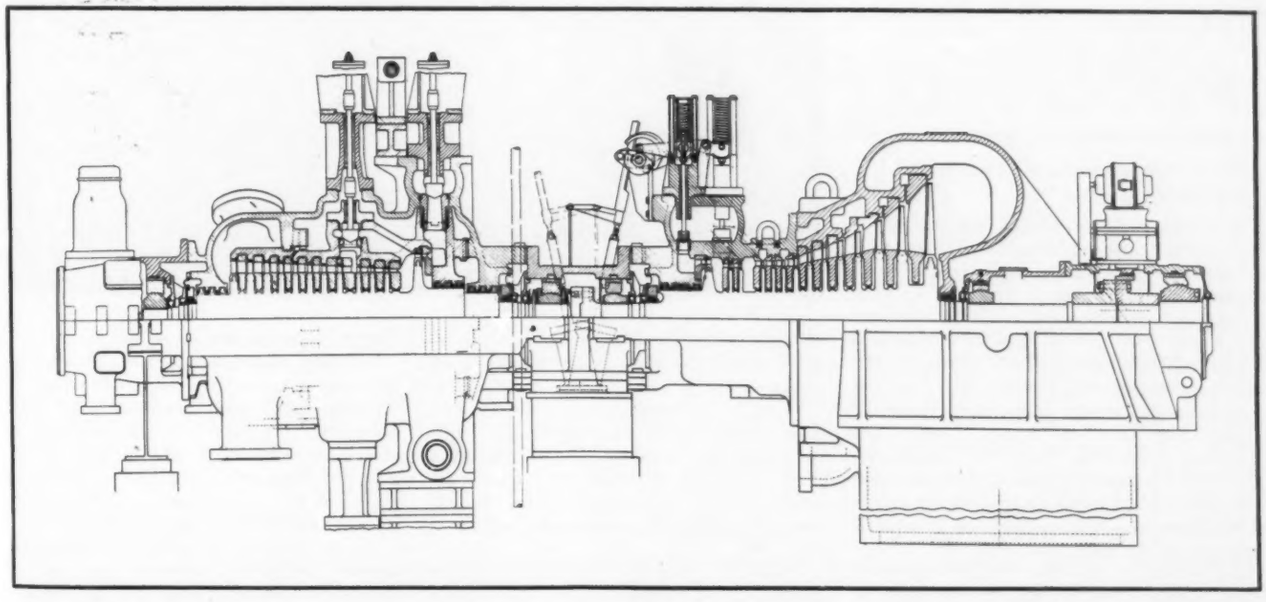
As has been mentioned, there are two distinct steam-operating cycles in the plant: (1) A complete cycle for the generation of electric energy in which steam is generated and delivered to the main turbo-generator, condensed and the condensate pumped back to the boilers through a closed system of feedwater heaters; (2) the evaporation cycle in which the process steam for the refinery is generated from water supplied by the refinery from a local supply. In this cycle steam exhausted from the high-pressure turbine is passed through evaporators in which heat is exchanged through coils of copper tubing to the refinery water, thus generating process steam. Delivery to the refinery is maintained at 160 lb. per sq.in. pressure and 50 deg. F. superheat. In all, ten horizontal evaporators were purchased for the three stations, three each for Avon and Oleum and four for Martinez. Each evaporator has 7,500 sq.ft. of heating surface and will produce 102,000 lb. of steam per hour with heat head of 17 deg. F. The evaporators are coil type with welded steel shells 9 ft. diameter by 40 ft. long. Tubes are of arsenical copper.

The tandem-compound steam turbines are unique among Pacific Gas & Electric units. Each consists of a combination of high-pressure, non-condensing, 3,600-r.p.m. turbine coupled to a single-flow, 3,600-r.p.m. moderate-initial-pressure condensing machine. The inlet ends of the two machines are put together on either side of the middle bearing pedestal with the shafts solidly bolted together with forged-on couplings and the thrust bearing in between the two machines. The main exhaust of the high-pressure turbine is downward and the two auxiliary pipes leading into the inlets of the low-pressure turbine are from the upper half of the casing and over the top of the high-pressure unit down into either side of the nozzle chest of the low-pressure turbine. This arrangement simplifies the unit and greatly simplifies the foundation, provides ease of expansion in the piping and results in less exhaust loss in the high-pressure unit.

### *Back-pressure Governing*

Through a combination of speed and automatic extraction governing, operation of the turbines has been worked out in such a way as to permit controlling the high- and low-pressure turbines almost as though

[*Continued on page* 114]



**CROSS-SECTION of 50,000-kva. tandem-compound turbine consisting of a high-pressure non-condensing unit coupled to a single-flow moderate initial pressure condensing machine**

# Overcompensation of Regulators Aids Voltage and Loading—II

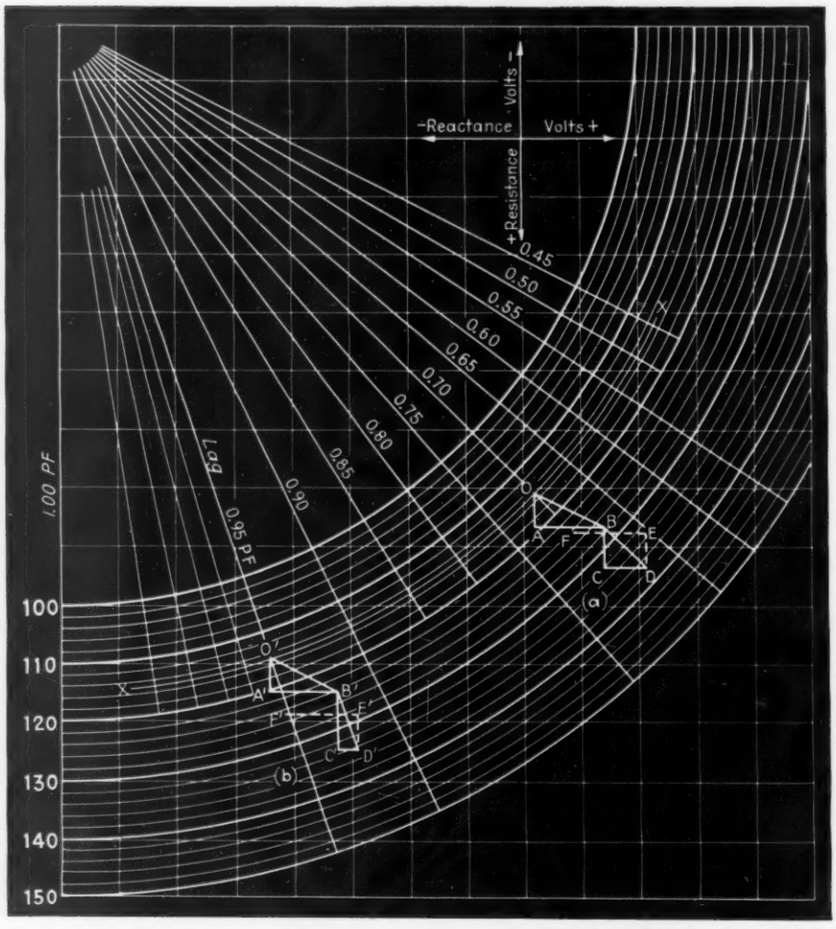
*Careful calculation of overcompensating settings of voltage regulators on express feeders resulted in improvements on a system subjected to abruptly increasing load*

*P. J. CARLIN and L. L. STAHLER,* Florida Power & Light Company, Miami.*

PARTICULARLY with capacitors on an express feeder, it is necessary to vary the overcompensation components in the line-drop compensators on different feeders to meet power-factor conditions prevailing on each feeder at time of maximum load. This was discussed in the preceding article. That a change in power factor necessitates a change in compensator components of the same voltage is to be maintained at peak load can also be inferred from (a), (b) in the accompanying illustration.

Once this point is recognized the difficulties encountered in overcompensating regulators can be overcome and a workable method of calculating compensator settings developed. The method, in essence, developed as a result of our analyses is as follows:

1. The regulator voltage control relay is balanced at 115, with a regu-




* Adapted from recent paper before engineering and operations section, Southeastern Electric Exchange, "Electrical World," April 5, May 17, 1941.

**EFFECT of power factor on regulator operation**

It is assumed two feeders have identical electrical characteristics which require a line-drop compensator setting of 6 resistance and 12 reactance volts to maintain constant voltage at the end of the express feeder or the point of regulation. Assumed that minimum or no load voltage is 115 and maximum load voltage 125. The load on these two circuits is the same in kva. at peak, but the power factor on one is 95 percent and on the other it is 70 percent.

The triangles OAB and O'A'B' represent the impedances of the express feeders serving these two circuits and are of exactly the same 6R and 12X. With the voltage control relay balanced at 115 the regulators will maintain that voltage at the point of regulation under all conditions of load. If it is desired to increase the voltage to 125 at full load it becomes necessary to introduce additional impedance in the compensator circuit.

(a) This represents feeder with 70 percent power factor load, seven additional resistance and seven additional reactance volts have been introduced in the compensator circuit as represented by the lines BC and CD, giving a compensator setting of 13R, 19X.

Under full load the drop in the express feeder will be 6 resistance and 12 reactance volts, which is plotted along the lines DE and EF respectively, and the voltage at the feeder center is 125 as shown by point F.

(b) This represents feeder with 90 percent power factor load. Nine additional resistance and 3 additional reactance volts have been introduced in the compensator circuit as represented by the lines B'=C' and C'=B', giving compensator setting of 15-R and 15-X as compared to the setting of 13-R and 19-X on feeder 12-A.

Under full load the drop in the express feeder will be 6 resistance volts and 12 reactance volts as represented by the line D'E' E'F' respectively, and voltage at the feeder center is 125 as shown by point F'.

## Table I—Resistance and Reactance Settings for Flat Compensation of 4-Kv.-Y Feeders

This table gives compensator resistance and reactance settings per 1,000 ft. for those express feeder conductors and current transformers generally used. Resistance is based on HD copper 77 deg. F., 25 deg. C. Reactance is based on mean separation potential transformer ratio — 20:1

| Wire Size (Stranded) | Resistance C. T. Primary Rating, Amp. (Secondary Rating 5 Amp.) | | | | Reactance C. T. Primary Rating, Amp. (Secondary Rating 5 Amp.) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 125 | | | 150 | | | 200 | | | 300 | | |
| | 125 | 150 | 200 | 300 | A | B | C | A | B | C | A | B | C | A | B | C |
| 2 | 1.03 | 1.25 | 1.67 | 2.50 | 0.950 | 0.867 | 0.884 | 1.13 | 1.04 | 1.06 | 1.51 | 1.39 | 1.41 | 2.27 | 2.09 | 2.11 |
| 0 | 0.645 | 0.78 | 1.05 | 1.57 | 0.916 | 0.834 | 0.866 | 1.10 | 1.00 | 1.04 | 1.46 | 1.34 | 1.39 | 2.19 | 2.01 | 2.09 |
| 00 | 0.515 | 0.63 | 0.83 | 1.25 | 0.892 | 0.820 | 0.850 | 1.07 | 0.98 | 1.02 | 1.43 | 1.31 | 1.37 | 2.15 | 1.97 | 2.05 |
| 000 | 0.406 | 0.50 | 0.66 | 0.99 | 0.875 | 0.804 | 0.834 | 1.05 | 0.96 | 1.00 | 1.41 | 1.29 | 1.34 | 2.11 | 1.93 | 2.01 |
| 0000 | 0.322 | 0.39 | 0.52 | 0.79 | 0.866 | 0.781 | 0.823 | 1.04 | 0.95 | 0.99 | 1.38 | 1.26 | 1.32 | 2.07 | 1.89 | 1.97 |

Note 1 — For flat compensation of two or three regulators in a 2.4-kv. delta circuit and where the three current transformer secondaries are connected in delta to the three-phase tap of the live drop compensators, multiply table values by 1.73.

Note 2 — If using a 600-amp. C. T. use values shown under 300-amp. C. T. multiplied by 2, etc.

lating band width of two to three volts, depending upon the regulator and the type of load on the feeder, the band being kept to the lowest possible minimum and yet avoid hunting of the regulator.

2. The reactance of each conductor in the express feeder is calculated separately, using a spacing equal to the square root of the product of separation between the other two conductors.

The resistance is, of course, the same for each conductor in the express feeder, assuming all conductors to be of the same diameter.

3. The power factor is determined at peak load and this is used to determine the reactance and resistance needed to overcompensate the regulator.

### *Overcompensation Method*

For convenience and ease in calculating compensator settings the reactance and resistance per 1,000 ft. has been calculated for all wire sizes and current transformers commonly used on the system (Table I).

The values of reactance and resistance to be used for overcompensation have also been placed in tabular form (Table II).

A problem in compensator settings involves a 4-kv. express feeder consisting of 1½ miles of No. 4/0 copper, with 200-amp. regulators serving a load with a power factor of 90. The solution is indicated in Table III.

### *Method Standard*

This method of calculating compensator setting has proved so successful and has resulted in such a marked improvement in consumer's voltage regulation that it has been made standard practice throughout the system.

A typical primary voltage chart taken at the end of an overcompensated express feeder which is fully loaded at peak has shown that the voltage varies with the load, ranging from 119 at minimum load to 125 at maximum load.

A secondary voltage chart from an overcompensated feeder was obtained in what was considered an "average consumer" area in terms of distance from the end of the express feeder. While the voltage dropped to a low of 114 between midnight and 6 p.m., it rose to approximately 116 during the hours of maximum load between 6 and 10 p.m.

The result obtained from overcompensating regulators was primarily the improvement of consumer voltage regulation. This unquestionably increased revenue, decreased low-voltage complaints and improved customer-company relations. However, it is difficult to evaluate these accomplishments.

It should be apparent, however, that some capital expenditure would have been necessary to have accomplished the same results by other methods, such as the installation of more feeders or larger feeder copper. Just how much this expenditure might have been is a matter of conjecture.

We know that this method of overcompensating regulators has resulted in the regulated bus voltage being increased approximately 100 volts primary during the peak period without in any way affecting voltage at lighter load periods.

[*Continued on page 52*]

## Table II—Additional Settings for Overcompensation of Regulators on 4-Kv.-Y Feeders

This table gives the amount of additional resistance and reactance which, when introduced in the compensator circuit, will result in 125 volts at the end of the express feeder with the voltage control relay balanced at 115 volts and full rated load on the regulator. The values of resistance and reactance are to be added to the resistance and reactance of the express feeder as derived from Table I.

| Power Factor of Load | Value of R | Value of X | Power Factor of Load | Value of R | Value of X |
|---|---|---|---|---|---|
| 65% | 6.5 | 7.6 | 83% | 8.3 | 5.5 |
| 66 | 6.6 | 7.5 | 84 | 8.4 | 5.4 |
| 67 | 6.7 | 7.4 | 85 | 8.5 | 5.2 |
| 68 | 6.8 | 7.3 | 86 | 8.6 | 5.1 |
| 69 | 6.9 | 7.2 | 87 | 8.7 | 4.9 |
| 70 | 7.0 | 7.1 | 88 | 8.8 | 4.7 |
| 71 | 7.1 | 7.0 | 89 | 8.9 | 4.5 |
| 72 | 7.2 | 6.9 | 90 | 9.0 | 4.3 |
| 73 | 7.3 | 6.8 | 91 | 9.1 | 4.1 |
| 74 | 7.4 | 6.7 | 92 | 9.2 | 3.9 |
| 75 | 7.5 | 6.6 | 93 | 9.3 | 3.6 |
| 76 | 7.6 | 6.5 | 94 | 9.4 | 3.4 |
| 77 | 7.7 | 6.3 | 95 | 9.5 | 3.1 |
| 78 | 7.8 | 6.2 | 96 | 9.6 | 2.8 |
| 79 | 7.9 | 6.1 | 97 | 9.7 | 2.4 |
| 80 | 8.0 | 6.0 | 98 | 9.8 | 1.9 |
| 81 | 8.1 | 5.8 | 99 | 9.9 | 1.4 |
| 82 | 8.2 | 5.7 | 100 | 10.0 | 0.0 |

Note — For overcompensation of two or three regulators in a 2.4-kv. delta circuit and where the three C. T. secondaries are connected in delta to the three-phase tap of the line drop compensators use table values.

## Table III—Example of Overcompensation

To compensate the regulators on a 4-kv. wye circuit so that 115 volts will be delivered at the end of the express feeder at no load and 125 volts will be delivered when the 200-amp. regulators are fully loaded.

**Field Data Required**

1. Primary rating of current transformers controlling regulator ..... 200 amp.
2. Conductors comprising express feeder 1½ miles of No. 4/0 copper or 7.92 M ft.
3. Power factor at maximum load on feeder ..... 90%

| *Solution:* | Phase A | | Phase B | | Phase C | |
|---|---|---|---|---|---|---|
| | R | X | R | X | R | X |
| From Table I, the flat compensation is 7.92 times table values for No. 4/0 or ..... | 4.11 | 6.85 | 4.11 | 6.19 | 4.11 | 6.51 |
| From Table II, over-compensation for 90% PF is | 9.00 | 4.30 | 9.00 | 4.30 | 9.00 | 4.30 |
| and the compensation required to give the desired result is ..... | 13.— | 11.15 | 13.— | 10.49 | 13.— | 10.80 |
| or (in nearest integers) ..... | 13 | 11 | 13 | 11 | 13 | 11 |

# Three-Phase Network for Denser Loads—I

***Hartford's downtown distribution system undergoes economical change in order to meet the increasing demands***

*J. H. AHRENS and R. C. FOSBERG, Distribution Department, Hartford Electric Light Company*

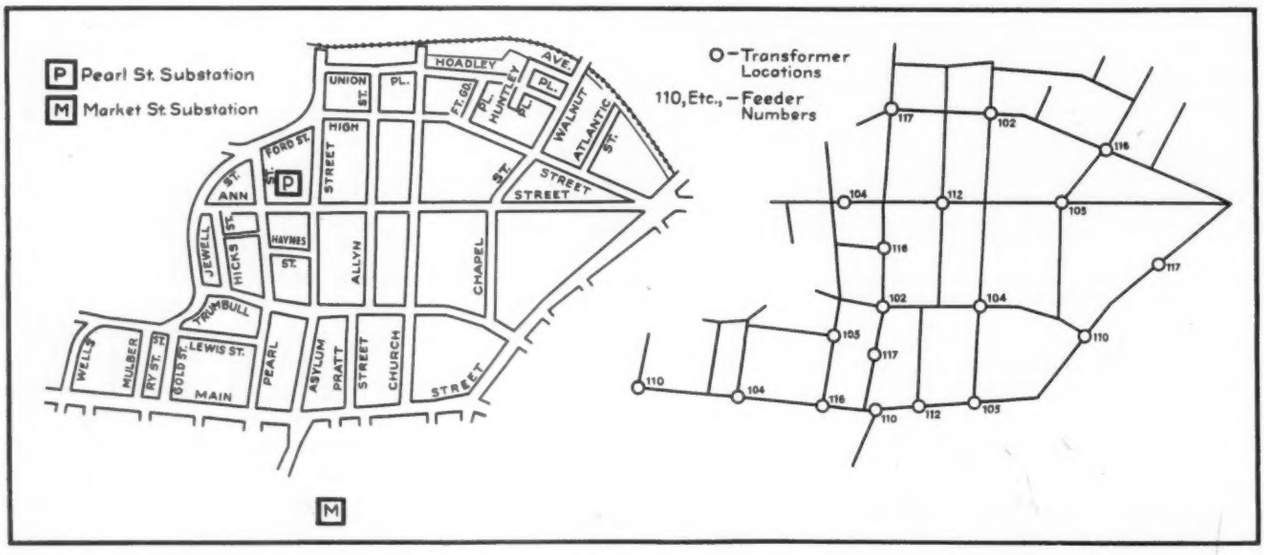
LIMITATIONS of Hartford's downtown secondary distribution due to growing loads have brought about a four-year program to change the existing two-phase, 115/230-volt, five-wire radial system into a three-phase, 120/208-volt, Y, four-wire network to serve the heart of the business district, bounded in general by Main Street, the Park River and New Haven Railroad. Since 1926, when the distribution of direct current ended in this area, small blocks of load have been served by a secondary grid supplied by street manhole transformer banks and large blocks by individual transformer banks in building vaults. Eleven 4.8-kv. radial feeders from Pearl and Market Street substations have supplied the transformer banks in both locations. Continuation of this system would have demanded the construction of larger transformer manholes offset from main line ducts, the purchase of large subway type transformers, an ultimate increase in secondary copper size and the installation of 7,500 kva. in transformers at Market Street.

### *Substation Capacity Released*

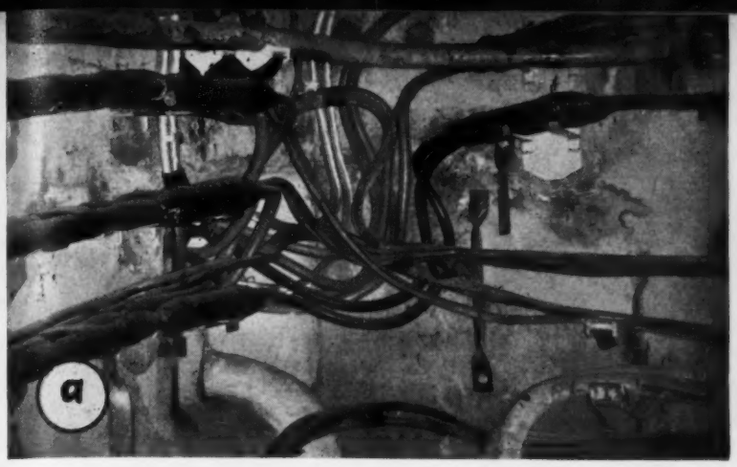
With load growing at the rate of about 5 percent per year in this area, major revamping of the system was clearly indicated. All available transformer space was being utilized in the existing manholes and additional transformer space in the street was at a premium. By going to the low-voltage network system a smaller number of larger transformer units meets the space problem effectively; substation capacity is released through the use of generator voltage in network transformer primaries; a high degree of service reliability is insured, and flexibility with regard to load growth, operation and maintenance is assured. Safety, operating economy and good voltage regulation are also provided.

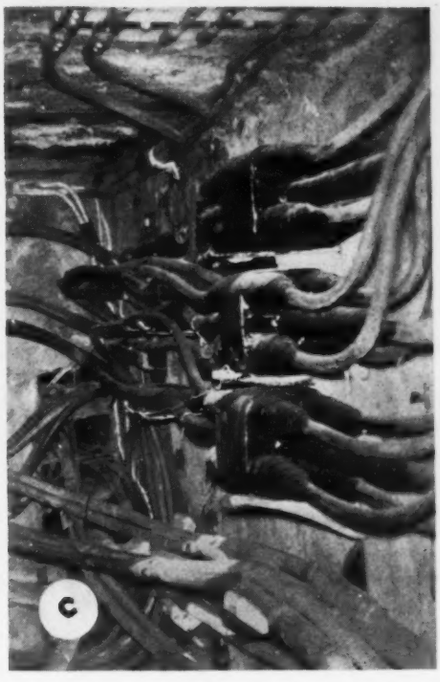
It was decided to make the network system three-phase because of the lower first cost of equipment, both to the consumer and the utility, and the ever-increasing difficulty of obtaining two-phase equipment.

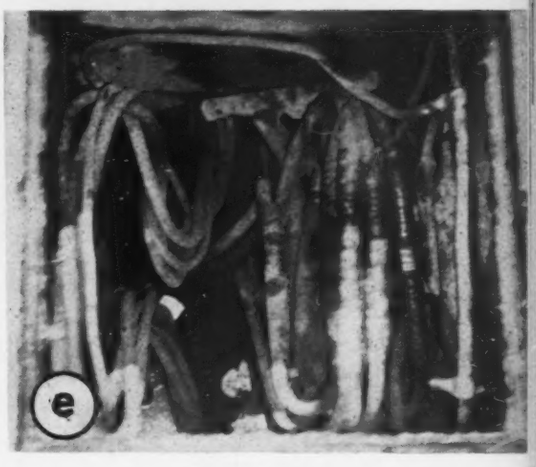
The low-voltage network system is being installed in steps in an area of




**URBAN CENTER** in which network is being installed in serial program (left). Single-line diagram of secondary grid (right)







**MAIN LINE MANHOLE from which transformer vault is offset**

(a) Corner showing 11-kv. transformer leads entering duct line to transformer vault at lower left, and twelve transformer secondary leads with four neutrals entering manhole from transformer vault. Six straight limiters and three two-way, two-way flat crabs on south wall and six straight limiters on west wall are shown.

(b) Three limiter crabs on south wall, with flat neutral crab on ceiling.

(c) Three two-way, two-way flat crabs and three limiter crabs on north wall, with flat neutral crab on ceiling.

(d) Northeast corner showing cables entering duct lines to north and east.

(e) Service box interior, showing two upper tier secondary cables and secondary sub-main terminating in two-way, two-way flat crabs for two service taps.

0.24 square mile. At present only the services from the secondary mains in the street are being changed over and cut into the network. The 4.8-kv. building vaults and necessary 4.8-kv. feeders serving them will remain for the present, but as conditions require, these will be changed over and supplied from the network. The load density in 1938–39, when the decision was made to install the network in the area served, was 46,100 kva. per square mile, of which 27,700 kva. was due to building vaults and the balance to transformer banks in street manholes. In this area there were 85 single-phase transformers in street manholes totaling 5,088 kva. and 98 single-phase building vault transformers aggregating 11,856 kva.

The existing duct system in general consists of a bank three ducts wide and three or more ducts deep, with manholes at every street intersection and 194 ft. apart on the average on tangent runs. Between manholes, as load taps require, are service boxes in which only the top tier of three ducts appears. One top tier duct carries the series street-lighting circuit, and the two others one secondary phase per duct. As the street-lighting circuit is to remain, only two ducts are available for the secondary network cable, and these are already occupied by the present radial secondary cables. Because both radial and network systems must be in simultaneous operation to facilitate cutover, it is necessary to pull the network cable into the ducts occupied by the radial cable. As the inside diameter of these ducts is only 3.5 in. there is insufficient room to install the conventional eight-conductor No. 4/0 network cable, and therefore a four-conductor No. 4/0 cable is being used.

### *Build Vaults*

To accommodate the network transformer units nineteen vaults will be built in the ultimate development, sixteen to be under sidewalks. This was decided upon because (1) most of the existing manholes could not be enlarged because of street congestion; (2) those which could have been enlarged would have had to be bigger than the network units require, since they would also have to house the

**TYPICAL sidewalk vault location**

present radial equipment until after the cutover; (3) enlarged manholes would have jeopardized important tie lines by the placing of network units in the same vault.

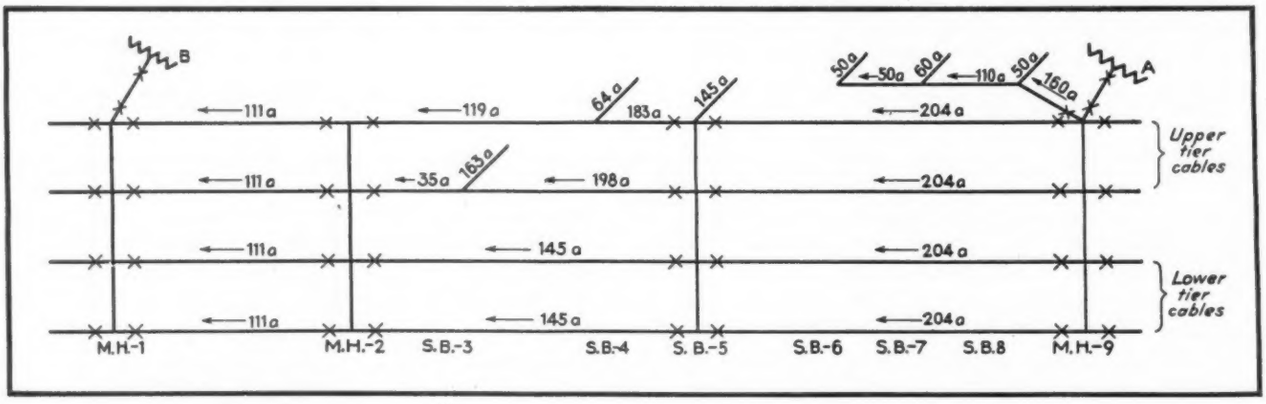
### *Vaults Designed for Accessibility*

The street vaults are 6 ft. 4 in. x 14 ft. x 7 ft. (high) inside, sidewalk vaults being 8 ft. high to allow for possible street widening. Roofs are the removable slab type with gratings at either end. Access is had through half of one grating at the secondary end of the vault. The concrete slab is only removed on the rare occasion of the replacement of the entire transformer unit. On the floor directly below the inner grating edges are concrete curbs with overflow pipes to keep debris falling through the gratings away from the transformer base and to permit drainage to the sewer system. All vaults have sewer connections in the secondary end opposite the duct entrances. Transformers are mounted in a 3-in. high concrete ring filled with plastic cement to seal the tank base against corrosion. Transformer cases are grounded to copper coils placed below the vault floor and all ducts leading into the vaults are sealed tight.

### *Primary Feeders*

There will be seven 11-kv., three-phase, three-conductor, No. 4/0 paper and lead primary feeder cables, four being tapped off the South Meadow steam plant-Pearl Street tie lines and three off the South Meadow-Market Street ties. These will be interlaced to feed the vault transformers and jointed to three single-conductor No. 1/0 varnished cambric and lead transformer leads in the main line manholes nearest the transformer vaults. These leads are made up to a three-position disconnecting and grounding switch in the high-voltage chamber on the primary side of the transformer.

Each transformer is a 500-kva., three-phase unit of the submersible oil-filled type, with welded on cover, connected in delta on the 11-kv. side and in Y on the secondary, delivering 125/216 volts and having 5 percent impedance. Transformer-mounted 1,600-amp. sensitively operated protectors are used. Type Z-25




**USE of calculating board in design**

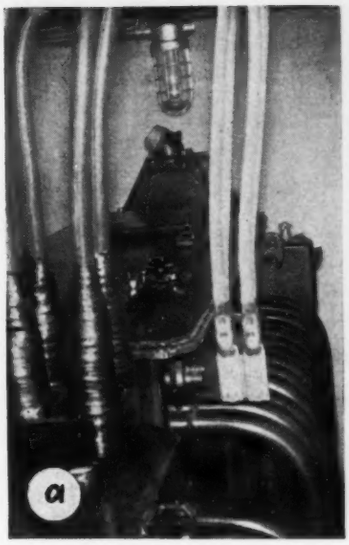
Design criteria permits no transformer or cable to be overloaded with one feeder out of service nor secondary regulation to be greater than 3 percent with all transformers in service or 5 percent with any single feeder out of service. The design is based on expected loads five years hence, obtained by increasing present loads 5 percent per year to allow for load growth. These loads were set up on a calculating board and the proper location and size of transformers and number of multipled No. 4/0 secondary cables determined. Transformer and cable loadings were then obtained from the board under normal and feeder-out conditions. Short-circuit currents and cable regulation were figured mathematically.

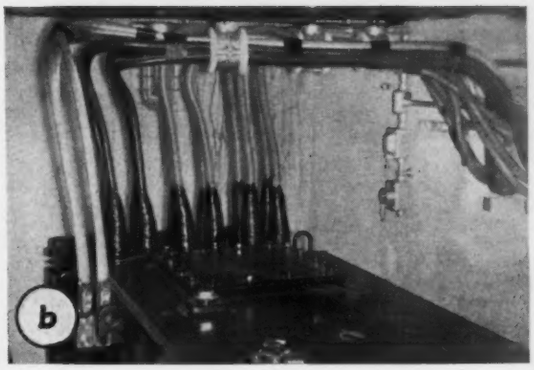
Services were allocated to the two upper tier cables to keep the loading of these two cables as nearly equal as possible.

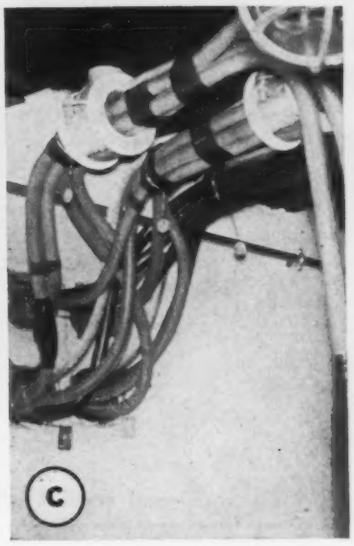
This calculation was simplified by assuming identical voltage levels at each tie point and then adjusting for this assumption and for the "through" current by using the calculating board values. Loadings in each cable section were thus obtained and additional tie points and/or sub-mains added to relieve any overloaded cables.

In the diagram is shown the necessity for installing secondary sub-main and additional tie in service box to prevent overloading of upper tier cables to the left of manhole No. 9 with transformer B out of service. Installing tie in service box requires deepening as upper tier cables only would normally appear.

X—Limiters. SB—Service box. MH—Manhole.







**TRANSFORMER vault interiors**

(a) Limitered protector secondary terminals and cables; primary wiping shield at rear.
(b) Transformer from primary end of vault.
(c) Method of suspending secondary leads from vault ceiling at duct entrance.

fuses are used to co-ordinate with the cable limiters.

Transformer secondary leads consist of four 500,000-cir.mil, rubber-insulated, neoprene-jacketed cables per phase and four 500,000-cir.mil bare neutral cables. These cables are tagged for phase leg identification and in addition are manufactured with a colored rubber insulation (red, green and black for Nos. 1, 2 and 3 phases respectively) for positive checkup. Transformer leads are limited in the protector bushings as well as in the nearest manhole to the transformer vault before being paralleled and tied into the secondary grid through limiter crabs.

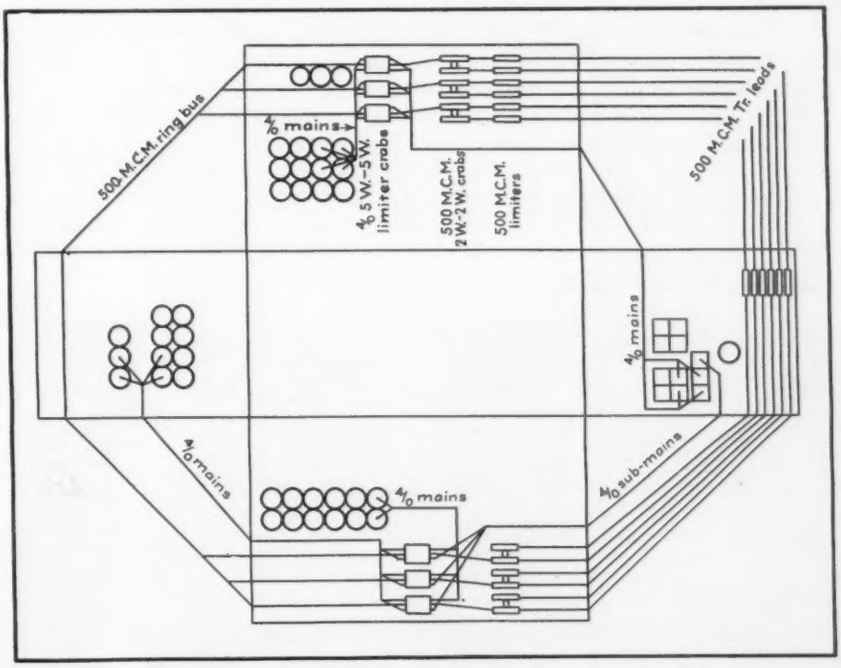
### *Secondary Grid*

The secondary grid in general consists of three or four four-conductor, 4/0 cables, each consisting of three color-coded, rubber-insulated, neoprene-jacketed phase conductors and one bare neutral conductor. They are tied together through limiter crabs in all manholes adjacent to transformer vaults and all three-way and four-way manholes to form a true grid. They are also tied together in two-way manholes if necessary to increase the available short-circuit current or to divide the load satisfactorily. Only two cables appear in all service boxes and are therefore available as service take-off cables. The other one or two cables run direct in the lower tier ducts from manhole to manhole and act as equalizing cables. In order to keep the loading of the top two cables from being excessive where manholes are far apart or where service loads between manholes are high it is necessary either to enlarge service boxes to permit tying the cables together between manholes or to run sub-mains from a manhole in which all cables are tied together to pick off some of this load.

Transformers are oversize with respect to the load, so that when one or two feeders and attendant transformers are taken out of service the remaining feeders and attendant transformers will automatically pick up and redistribute the load without becoming seriously overloaded. The large amount of copper is necessary because the greater spacing of transformers in this system produces larger secondary currents and greater voltage drop per unit of street length than do more transformer units closer spaced. In addition, the system is designed so that customer voltage will be satisfactory with one or two feeders out of service. General Electric built the network transformers and protectors.

Load growth can be taken care of at any time by installing additional units in strategic locations in the network area, and without any customer outage.

Specific problems encountered in making the actual changeover will be discussed in a subsequent installment.




**TYPICAL four-way duct manhole layout adjacent to vault, omitting primary and secondary ducts and showing limiter crab arrangement**

# Amortisseur Windings for Hydro Generators

***They control hunting, reduce overvoltages due to faults, aid in riding through disturbances, provide torque for synchronizing and reduce breaker recovery voltage rates***

*S. B. CRARY* and W. E. DUNGAN,† General Electric Company, Schenectady, N. Y.*

VIRTUE in providing amortisseur windings on generators is somewhat obscured by the common feeling that they are appropriate for synchronous motors and condensers, but less necessary for synchronous generators which are brought up to speed by their prime movers before synchronizing. However, experience and theoretical considerations show that amortisseur windings for waterwheel generators afford benefits which may be expected to increase their use. Nor is it necessary to sacrifice mechanical characteristics in order to obtain desirable electrical characteristics.

### *Starting Synchronous Machines*

Amortisseur or damper windings are built in the rotor pole faces of synchronous motors and condensers in order that these machines can be started from rest and brought up to synchronism, or to a speed from which they can be synchronized, as induction motors. The field winding does not provide sufficient torque for this purpose. Under the starting condition, the field is usually short-circuited through a discharge resistance of limited amount, in order that it can provide as much torque as possible without excessive voltage appearing across the slip rings.

Turbine generator rotors are usually built from solid steel forgings which provide what is, in effect, a good amortisseur or damper. If the turbine generator is to be used to supply an appreciable amount of single-phase load, it may be necessary to install an amortisseur winding in order to prevent overheating and damage to the rotor. Ordinarily, it is not required for three-phase operation. Salient-pole generator rotor pole pieces, on the other hand, usually are built of steel laminations. This construction does not provide an appreciable amortisseur or damper winding effect.

Accordingly, the question of whether or not an amortisseur winding should be used ordinarily arises only in the case of salient-pole generators, waterwheel, engine-driven and small-geared turbine-driven generators.

The following discussion will be concerned chiefly with waterwheel driven generators, although in general the same discussion with a few exceptions applies to the other types of drive as well.

The chief disadvantages of the use of amortisseur windings are:

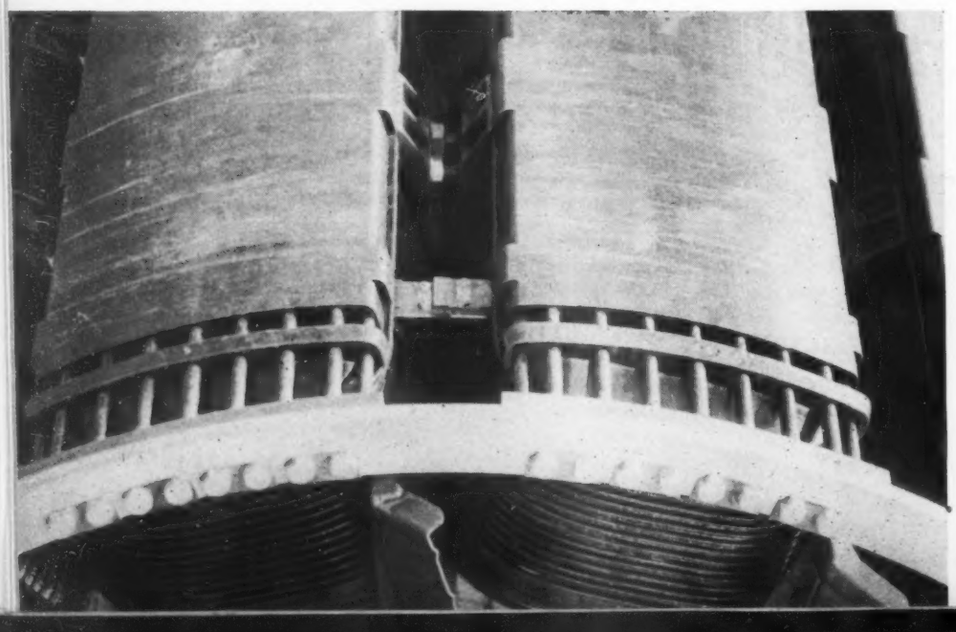
(a) Increased cost, about 1 to 2 percent of the cost of the generator.

(b) Increased stresses on generator and connected apparatus due to increased short-circuit current.

(c) An additional winding in the rotor which must be built to withstand the stresses at the maximum or overspeed condition.

*Central station engineering department.
†Motor and generator engineering department.

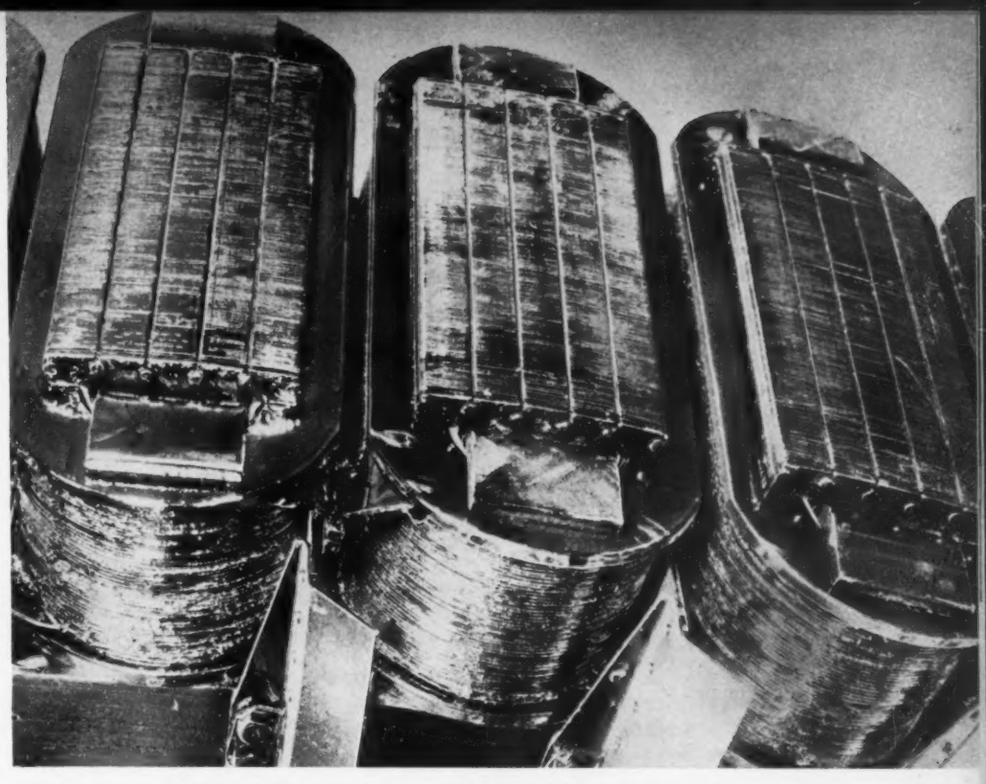
**TYPICAL complete amortisseur winding on a waterwheel generator**



### *Amortisseurs Reduce Hunting*

1. Amortisseur windings reduce or eliminate the hunting on sustained pulsations in current and voltage that are noticeable under certain conditions of operation of a synchronous generator. This is most likely to occur with a generator which does not have an amortisseur winding and which is connected to its load or system by lines which have an appreciable amount of resistance. This effect usually becomes more pronounced at light kilowatt load, so that it may be actually impossible to operate the generator at zero kilowatt load as an overexcited synchronous

condenser. If series capacitors are used in the line connecting the machine with the system the tendency for the generators to hunt may be aggravated to such an extent that amortisseur windings would be required.*



**TYPICAL incomplete amortisseur affords compromise between ideal mechanical condition (no amortisseur) and ideal electrical (fuel amortisseur) condition**

### *Minimize Overvoltages*

2. Amortisseur windings are effective in reducing the overvoltages due to unbalanced faults. This is a factor of importance in the application of lightning arresters and other protective devices. Lightning arresters have been damaged due to unbalanced faults occurring on systems having waterwheel generators without amortisseur windings, when these generators were connected to overhead transmission lines with an appreciable amount of line charging capacity and when the lines were disconnected from the system or load. These are the conditions most favorable to the building up or occurrence of high voltages due to the third and fifth harmonic components of voltage, which are generated in a synchronous machine having unequal rotor impedance or saliency when an unbalance fault occurs. With the effort to co-ordinate insulation levels and provide proper protection for system equipment, the use of a properly designed amortisseur is a step in a direction which will allow further economies and improvements to be made.†

### *Ride Through Disturbances*

3. Amortisseur windings, because they damp out the oscillations more quickly, are of benefit in improving the ability of machines to ride through system disturbances, faults and switching operations. This gain in stability, however, is small. High-resistance amortisseur windings or a double amortisseur, having low- and high-resistance windings, were at one time proposed. The advantage of the high-resistance winding is that it provides a braking torque during the period in which an unbalanced short circuit is on the system.‡ This torque, to the extent that it loads the generator, is of benefit in increasing the stability limits. However, with quick switching and the need for systems to ride through the more severe three-phase faults, this one advantage of a high-resistance winding is not sufficiently important to justify its use over a low-resistance winding.

### *Enhance Synchronizing Torque*

4. Amortisseur windings are of value in providing additional torque for generators which are automatically synchronized, when such synchronization may occur when the machine is out of phase or slightly off system speed, and also in increasing the possibility of pulling back into synchronism in case synchronism is lost, following a system disturbance. The amortisseur windings give additional torque besides that provided by the main field winding, which may be quite limited except at a slip very close to synchronous speed.

5. Amortisseur windings are effective in reducing circuit breaker recovery rates, although they tend to increase the magnitude of current to be interrupted. As system circuit breaker recovery rates are usually considerably lower than those obtained at the circuit breaker short-circuit testing stations, and, therefore, lower than what the breaker is usually capable of interrupting against, amortisseur windings are not ordinarily required for this purpose.

### *Reduce Field Surges*

6. Amortisseur windings are also of benefit in protecting the field winding against current surges in the armature circuit which may be caused by lightning or internal short circuits. The amortisseur winding reduces the induced voltage in the individual field-pole windings and is a factor under these conditions in reducing the field circuit insulation stress. High voltage across the individual field poles of a synchronous machine may occur due to a short-circuited coil in the armature or stator winding. Also, relatively high voltages may appear across a field pole having a short-circuited field turn or turns, on the occurrence of a system or terminal fault. An amortisseur winding is effective in reducing the magnitude of the induced voltage which may occur across the longitudinal field poles under these conditions. The benefit to be obtained from an amortisseur winding in this case is that it reduces the possibility of additional damage to a machine which already has failed or is partially damaged.

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* "Stability of Synchronous Machines—Effect of Armature Circuit Resistance," by C. A. Nickle and C. A. Pierce, *A.I.E.E. Trans.*, v. 49, Jan., 1930, pp. 338-350, Dis. 350-351, 14 Figs.

* "Effect of Armature Resistance Upon Hunting of Synchronous Machines," by C. F. Wagner, *A.I.E.E. Trans.*, 1930, v. 49, pp. 1011-1024, Disc. 1024-1026, 18 Figs.

† "Unsymmetrical Short Circuits on Water-Wheel Generators Under Capalitive Loading," by C. F. Wagner, *Electrical Engineering*, November, 1937, pp. 1385-95.

† "Overvoltages Caused by Unbalanced Short Circuits—Effect of Amortisseur Windings," by Edith Clarke, C. N. Weygandt and C. Concordia, *Electrical Engineering*, August, 1938, pp. 453-468.

‡ "Damper Windings for Water-Wheel Generators," by C. F. Wagner, *A.I.E.E. Trans.*, v. 50, March, 1931, pp. 140-152.

7. It has been found that under certain system conditions the additional electrical damping as produced by a well-designed amortisseur winding is effective in reducing the tendency of the generator and its prime mover to hunt, such hunting being excited by the governor mechanism in attempting to regulate speed. This is one reason why similar governing mechanisms may have different margins of stability because of the difference in generator and electrical system characteristics. Although this advantage of amortisseur windings has not been so well recognized, it may in some cases constitute an important additional reason why they should be used.

Accordingly, amortisseur windings are considered to be generally beneficial and many waterwheel generators are so equipped. More recently there has been renewed interest in the use of amortisseurs, following the occurrence of a few cases of damage to lightning arresters which could be attributed to the phenomenon discussed under Item 2.

### *Important Benefits*

Probably of the six advantages, Items 1 and 2 are the most important. As discussed under Item 1, in some cases operation is impossible at light load unless an amortisseur is used, while under Item 2 damage to protective equipment may result.

In all of the above listed advantages, except Item 6, the amortisseur winding is beneficial because it tends to create in the quadrature axis of the rotor, *i.e.*, the axis between field poles, an electrical circuit which responds to changes in the armature or stator windings, in a manner approaching that of the rotor circuits which are symmetrical around the direct axis, *i.e.*, the axis of the field poles.

The effectiveness of this winding can be expressed quite well by the ratio of quadrature axis subtransient reactance to the direct axis subtransient reactance, $x''_q/x''_d$. If the quadrature axis circuits are as effective for transient changes as the direct axis circuits, $x''_q/x''_d$ is unity and one of the important criterions for an ideal amortisseur is satisfied. For machines without amortisseur windings the corresponding ratio varies from 1.6 to 2.0. From the theoretical work that has been done, $x''_q/x''_d$ is found to be a simple criterion for the effectiveness of amortisseur windings in accomplishing the more important desired advantages listed above. Methods have been developed and defined for testing for this ratio by static tests.

### *Design Compromise*

As in a good many other engineering problems, it is not practical to obtain the ideal condition without sacrificing some other desirable characteristics, while it is entirely possible to go a considerable distance toward the ideal without sacrificing too much. So it is in the case of amortisseur windings. To approach one of the ideal conditions, $x''_q/x''_d = 1$, it is usually necessary to make a direct connection between poles at the top of the pole so that the end connection will have a low resistance and reactance. On waterwheel generators which are required to withstand high overspeeds, it is desirable for mechanical reasons that there be no end connection at the top. Copper pole punchings at the ends of the pole stacking provide an electrical circuit of high conductivity between the amortisseur bars.

On generators equipped with the type of amortisseur described above, it is found that the ratio of $x''_q/x''_d$ can be reduced to a value of about 1.5 to 1.20, depending on the generator size, speed and proportions. For example, considering one of the proportions the length: the longer the machine the smaller the end connection reactance to the amortisseur bar reactance, and the easier it is to obtain a low ratio. Experience has indicated that amortisseur windings constructed in this manner are satisfactory mechanically and electrically. The electrical difficulties, which have come to our attention due to saliency effects, have been with machines having no amortisseurs. Since a large part of the advantages of using an amortisseur are practically obtained by an incomplete amortisseur, this has been found to be a good compromise between the ideal mechanical condition of no amortisseur and the ideal electrical condition of a complete amortisseur. Complete and incomplete types of amortisseurs are shown in the accompanying illustrations.

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## Overcompensation of Regulators

[*Continued from page 45*]

This increase in bus regulator voltage could have been utilized to increase the capacity of the express feeder. Had this increase in voltage been used for the purpose of increasing the capacity the results gained might be evaluated as follows:

From Fig. 2 of the preceding article it is seen that any increase in the length of line EF increases the allowable *IZ* drop or hauling ability of the express feeder. Measuring along line EF it will be seen that this increased voltage, namely, five volts (referring to secondary), is equivalent to 6.75 *IZ* volts and $6.75 \times 20 = 135.00$ *IZ* primary volts, further $135/0.72 = 193$ amp. and

$$\frac{193 \times 120 \text{ (former load center voltage)} \times 20}{1{,}000}$$

$\times 3 = 1{,}390$ kva.-miles, the increased capacity due to the 100-volt increase in regulated bus voltage.

The average regulated feeder on the system is approximately $1\frac{1}{2}$ miles in length and is regulated by a bank of 250-amp. regulators and costs approximately $20,000 to install, including oil circuit breaker regulators and express feeder.

Since this average feeder has a capacity of 3,525 kva.-miles (Fig. 11), it follows that a kva.-mile of feeder capacity must cost approximately

$$\frac{\$20{,}000}{3{,}525} = \$5.67.$$

It follows, therefore, that to obtain similar results by increasing the number of feeders would have cost $\$5.67 \times 1{,}390$ or $7,881 per existing feeder.

### *Value Proved*

How many additional feeders it might have been necessary to install had the existing regulators not been overcompensated is a matter of conjecture. However, this startling increase in feeder value of almost $8,000 per feeder, arrived at by this hypothetical evaluation method, definitely proves the value of properly applied methods of overcompensating regulators.

# Commercial Cooking Adds Revenue of $135,000

*Carolina Power & Light summarizes five-year growth of its step-by-step plan for commercial cooking — Gains new revenue for 10 cents per dollar, sells 4,748 kw. in 1940*

*M. H. HICKS,* Carolina Power & Light Company, Raleigh, N. C.*

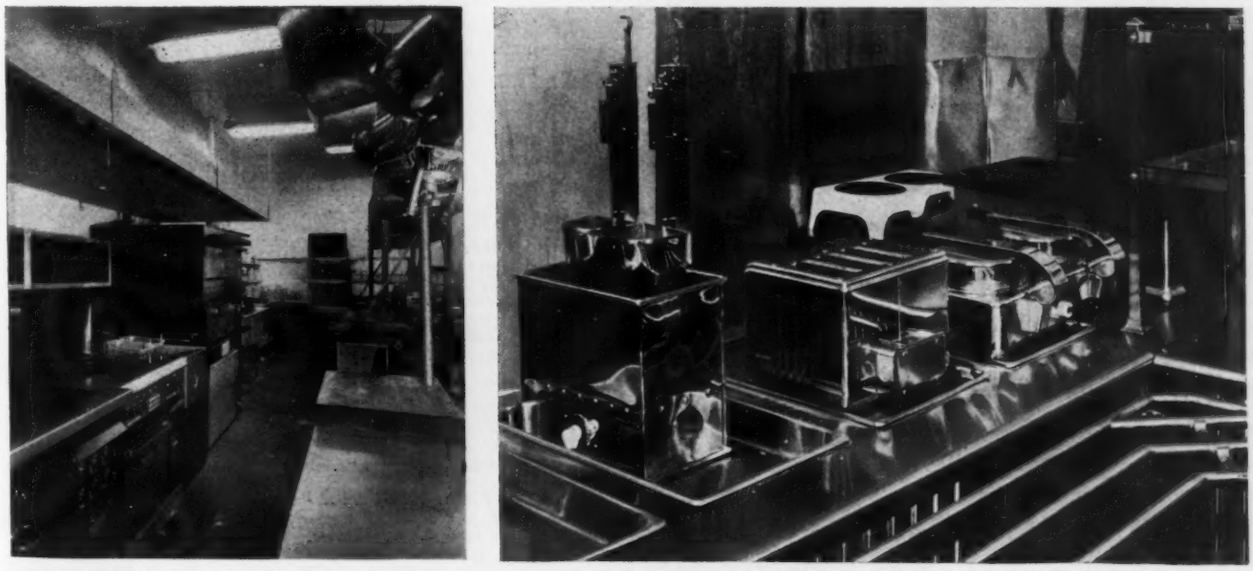
FOLLOWING closely along promotion lines which proved effective year by year since 1935, and without radical changes in sales methods, the Carolina Power & Light Company enjoyed a very satisfactory year in the advancement of commercial electric cooking throughout its territory in 1940. The continuation of tried and proved selling tactics led to kilowatt and E.A.R. increases considerably higher than the respective quotas for the year. A total of 4,748 kw. with E.A.R. to the amount of $135,000 were reported added for the twelve-month period. These figures represent electric cooking results alone, as electric water heating sales were charted separately.

Prior to 1935 the company had given only casual attention to the promotion of commercial electric cooking. Upon formation of the commercial sales department the task of introducing and popularizing electric cooking over a wide territory appeared to be a slow and tedious task, but from the start certain policies were adopted and, due to their practicability, have been consistently followed year by year. The showing made in 1940 was not spectacular; however, the totals were entirely satisfactory from the standpoint of immediate business and for their value as a foundation for the continuance of the work in the future.

As the commercial sales department operates under a general expense budget, it is impossible to determine with complete accuracy the exact cost of developing the electric cooking business in 1940; however, the expense can be very closely estimated as being approximately $14,000, which included salesmen's compensation, sales promotion advertising and a pro rata share of the department's over-all expense. In other words, in 1940 electric cooking business was secured at a cost of approximately 10 per cent of the E.A.R. created.

The effectiveness of commercial electric cooking activities in 1940 cannot be properly appraised without due regard to certain influencing factors. For instance, the company is distinctly a transmission type utility, a fact which will be recognized as having an important bearing upon all classes of sales endeavors. The territory served includes portions of western North Carolina, central-

* Commercial sales manager.



**STEP-BY-STEP PLAN of Carolina Power & Light results in all-electric, heavy-duty kitchen (with new fluorescent lighting) in this cafeteria, plus a battery of counter equipment**

eastern North Carolina and northern-central South Carolina and embraces 288 communities, only two of which can be classed as metropolitan centers. With the exception of these two cities, with an approximate 50,000 population each, and three cities of slightly above 10,000 population each, the vast majority of communities fall in the classification of small towns and villages. Entirely different conditions exist in a territory of this kind than in a large metropolitan area, and these differences drastically affect the sales opportunities of electric cooking equipment.

### *Small Towns*

In a smaller town lack of competition between food establishments, absence of regulatory laws and limited patronage restrict the number of food establishments and also tend to lessen the need for elaborate operating equipment. The help situation is another factor which affects the sale of electric cooking equipment in the South. Practically all kitchen work is performed by negroes and it should be noted that experience has shown that negro help can use electric cooking equipment advantageously if properly instructed in its use and care.

In addition to these factors the company is definitely committed to a policy of all-service selling and the sales organization structure does not permit the use of specialists. All commercial salesmen are required to give due time and attention to a variety of services, and the commercial department as a whole must divide its energies and appropriations in such a way as to place proper stress on air conditioning, lighting and other commercial services, without particular emphasis upon electric cooking or any other one service.

Some 18,000 commercial customers are served by the company, and of this number 10 per cent, or approximately 1,800, are considered prospects for electric cooking in one form or another. A steady effort is made to increase the number of electric cooking prospects by persuading additional commercial customers to establish luncheonettes or similar departments.

Customer contacts are made by a staff of seventeen full-time commercial salesmen who, as previously mentioned, are responsible for the sale of all services. This sales staff is supervised by five full-time sales supervisors who, in addition to supervisory work, serve as co-ordinators with local dealers and representatives of hotel and restaurant equipment manufacturers. The close supervision of salesmen in the field is the keynote of the selling plan and the sales supervisors are available not only to direct the work of the individual salesman but to assist in closing difficult orders and in carrying on various phases of promotion work.

As the company has a very broad dealer policy, a close co-ordination with its associated sales allies is essential. In 1940 practically all of the electric cooking equipment sold in the territory was supplied by dealers and representatives of hotel and restaurant equipment houses. The company does not stock any commercial heavy-duty cooking equipment and salesmen are urged to have customers place orders through associated sales allies whenever possible. In some cases where the customer, for one reason or another, expresses the firm desire to buy equipment from the company, the business is handled direct.

With a large and scattered territory the question of introducing and popularizing electric cooking in each community has been given most careful attention. Experience indicates that the most practical way of starting the use of electric cookery among the commercial establishments of a community is first to induce some local institution to make as complete an installation as possible. Within the past five years practically all of the leading hospitals and similar institutions in the territory have installed electric cooking equipment, and these installations have served a highly useful purpose as "test cases" in creating a demand from commercial establishments.

In 1940 particular attention was given to equipping orphanages and gratifying results were obtained. It has been found that institutions can be more easily persuaded to pioneer in electric cooking than commercial establishments, due to the fact that the many advantages of electric equipment can be supplemented by proof of the low per-meal cost of cooking electrically.

### *Step-by-Step Plan*

The basic plan employed in developing electric cooking sales is a relatively simple one which follows a step-by-step procedure. After electric cookery is introduced into an area via the institution route, a carefully prepared customer coverage campaign is launched with the primary objective of acquainting each prospect with the *profit* angle of electric cookery. In other words, prospects are made to realize that electric cookery will increase monetary profits, either through an actual saving in fuel and food costs or by stimulating the volume of business. Personal contacts and direct mail advertising are employed in this phase of the sales plan.

The next step is that of securing a demonstration of some popular type electric cooking appliance, usually the electric fry kettle, which has been found to be the one appliance which will always out-perform any competitive equipment and will pay for itself over a short period of time through net savings on the shortening alone. The fry kettle is easily demonstrated and offers so many advantages over other types of equipment that the demonstration invariably creates a favorable impression and almost instantaneous actual buying desire.

The next step is usually based on the demonstration and sale of an automatic griddle, the profit-making possibilities of which can be easily shown. This appliance will take care of practically the entire breakfast

## Typical Actual Operating Characteristics of Electric Kitchen Installations

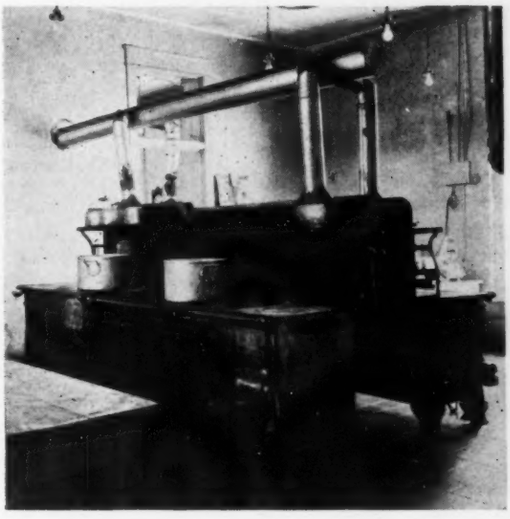
The following represents operating statistics for an average month in an orphanage with approximately 400 children:

| | |
|---|---|
| Meals served per day (Breakfast, lunch, supper) | 3 |
| Connected load, kw | 109 |
| Average billing demand, kw | 68 |
| Average kw.hr. per month | 10425 |
| Average cost per month | $155.25 |
| Average meals per month | 42,750 |
| Watt hours per meal | 244 |
| Cost per meal, cents | 0.363 |
| $27.40 per kw. year of billing demand. | |

### *Chain Store Luncheonette*

The following are typical monthly operating statistics for a 50-stool luncheonette: serving breakfast and lunch only:

| | |
|---|---|
| Connected load, kw | 105 |
| Average billing demand, kw | 40 |
| Average kw.-hr. per month, kw | 4567 |
| Average cost per month | $79.20 |
| Average meals per month | 18,200 |
| Watt hours per meal | 257 |
| Cost per meal, cents | 0.435 |
| $23.75 per kw. year of billing demand. | |



**FROM zero kw. to 108.5 kw. on one Carolina job. Dutch oven, circa 1850, and "Majestic Smoke-eaters" are replaced in this institution by modern equipment with a connected load of 108.5 kw.**

cooking in the average food establishment and will also serve a useful purpose for grilling steaks, chops and other foods for midday and evening meals.

The fry kettle and automatic griddle, upon which the first sales attention is concentrated, provide the customer with an excellent foundation for a complete installation of countercookery equipment, and these two appliances provide the company with a nice diversified load with a high load factor, which is, of course, a very desirable feature.

After a prospect is converted into a customer through the adoption of a fry kettle or automatic griddle, or both, the step-by-step sales process continues through the demonstration of various other electric cooking appliances, leading, wherever possible, to a complete installation of countercookery equipment as well as heavy-duty cooking equipment.

### *Demonstration Sells*

Actual demonstration of the various appliances by commercial salesmen on the premises of the prospect is undoubtedly the most effective part of the step-by-step sales plan. It has been proved time and time again that appliance demonstrations conducted in the company salesroom or in the store of an electrical dealer are not as productive as when conducted in the prospect's own place of business under his own actual operating conditions and in the presence of his operating staff. When the prospect can see how the fry kettle or automatic griddle handles his particular cooking needs and his employees see the many advantages which the equipment offers over other types, the securing of an order becomes a relatively easy matter. To confirm this fact, records show conclusively that at least 90 percent of the demonstrations made in the prospect's own place of business have resulted in the sale of appliances. Also, that a high percentage of complete electric cooking installations have resulted from the original demonstration of a single appliance. In several instances these demonstrations have created such interest on the part of employees that they have insisted upon the immediate purchase of the appliance.

In making appliance demonstrations the equipment is usually temporarily connected. If the sale is con-

[*Continued on page 112*]

# A.I.E.E. Talks Transmission, Breakers, Metering, Relaying

***Summer convention discusses vibration dampers, footing resistances, conductor galloping, linear characteristics of current transformers, short-circuit computations, and air-blast breakers and meter jewels***

WHILE the non-technical sessions of the annual convention of the A.I.E.E. at Toronto June 16-20, 1941, were addressed to the civic opportunities and duties of the professional engineer, the technical sessions stuck to the routine advancement of engineering. Except for a conference session on protective lighting the program had little of a specific defense nature.

Topics treated comprised a revival of the argument about the merits of grounding versus shielding or even of over-insulation of transmission lines, the efficacy of flexible vibration dampers, the errors of polyphase metering connections, benefits of cascaded breakers, the forward march of air-blast breakers and a simplification of the method of calculating and expressing fault currents.

**Chairman Thomas H. Hogg of the Hydro-Electric Power Commission of Ontario welcomed the American electrical engineers to Canada on behalf of Canadian engineers**

## Uninterrupted Transmission

**The 220-Kv. System of the Hydro-Electric Power Commission of Ontario**—II. By **A. H. Frampton** and **E. M. Wood** (both Hydro-Electric Power Commission).

Sequel to E. T. J. Brandon's 1930 paper, recording expansion from 350 miles and 180,000 kw. of major terminal to 1,000 miles and 420,000 kw., involving 8,400 circuit-mile-years of performance. Analysis justifies modification of tower design further to improve lightning and glaze performance by providing more clearance for conductors galloping in elliptical envelopes; simultaneous lightning gain. Counterpoise used at high footing resistance points. Carrier relaying superposed on standard two-stage impedance pattern.

**Conductor Vibration—Theory of Torsional Dampers.** By **J. W. Speight** (Hydro-Electirc Power Commission).

Gives mathematical theory of action of the torsional damper in rigid and resilient forms. For rigid dampers, distance from center of gravity to center of conductor should be short. A single damper with resilient joint is required for conductors with small damping capacity; it is superior to the rigid damper in that the damping factor of the resilient material can be varied advantageously.

**Measurement and Control of Conductor Vibration.** By **G. B. Tebo** (Hydro-Electric Power Commission).

Mershon magnetic method developed into linear measurement of small movement close to clamps. Test spans provided for studies of aeolian vibration and comparative clamp efficacy. Torsional damper found to permit less movement than the Stockbridge damper and without resonant response. Reduction of span length and tension provides less reduction in A.C.S.R. vibration stresses than application of good dampers. Loose-core A.C.S.R. is damped less effectively than standard-stranded A.C.S.R. with external dampers, but it does suppress upper frequencies. Armor rods are much less effective than dampers on large A.C.S.R.

**Lightning to the Empire State Building**—II. By **K. B. McEachron** (General Electric).

Of 49 strokes none was entirely positive, but 41 were entirely negative in polarity. Half had 25 coulomb charge or more, maximum 164. Low current components found in 91 percent. Half had at least 7,000 amp. crest. One-fourth exceeded 40 ms. Frequent rates of 10 to 20 ka. per ms., occasional 30 to 40. Inferred that lower ground resistances incur higher lightning currents.

**Field Investigations of Lightning.** By **C. F. Wagner, G. D. McCann** and **Edward Beck** (all Westinghouse).

Only 30 percent of arrester discharge currents found multiple (not over eight components) as against 50-70 percent direct strokes multiple (up to 32 components). Arrester components of low crest magnitudes; only 30 percent over 1,000 amp. Most severe arrester duty on ungrounded system, least on four-wire ground neutral circuits. New arrester (40,000 arrester-years of service) has lightning failure rate of 0.045 percent. Long durations appear to attend high earth resistivity.

Why low ground resistance should not be of greater concern than shielding angle was a question which puzzled M. S. Oldacre (Commonwealth Edison) and Chairman A. S. Runciman (Shawinigan). Llewellyn Evans (TVA) likes the idea of marginal insulation "for a line you want to have stay in"; one 154-kv. Pickwick-Memphis line insulated for 161 kv. has had several outages, but one insulated for 220 kv., even with footing resistances up to 150 ohms, has had none. E. W. Knapp said the Shawinigan company has been successful with automatic re-

I. F. Kennedy, General Electric; G. E. Quinn, Consolidated Edison; C. L. Smith, Rochester Gas & Electric. Convention Committeemen—T. W. Hill (Publicity), *Electrical News*; W. J. Gilson (Entertainment), Eastern Power Devices; S. C. Watson, N. Slater Company; A. H. Frampton (General), Hydro-Electric Power Commission

closing on loads up to 175,000 kva., but he was not sure of stability with 675,000 kva. on four H.E.P.C. 220-kv. circuits unless reclosure were applied.

In closure, A. H. Frampton said they expect to get carrier through all faults (except possibly those close to stations) with 400 watts input. Experience with a 132-kv. line temporarily without ground wire (22 faults in 1940 despite ground resistances all less than 5 ohms) made him doubt whether ground resistance is the ruling factor asserted by others.

Tests at Massena on full-length spans have shown that armor rods decrease vibration amplitude up to 60 percent and hours of vibration up to 50 percent, said G. W. Stickley (Aluminum Co.) He added that armor rods should have twist direction same as outer layer of conductor. He contradicted the failure conclusions of the Tebo paper by citing the unbroken 26-year record of the 500,000-cir.mil ACSR Massena-Cedar Rapids line, which exhibits practically daily vibration.

Whether data about high-building lightning means much in terms of transmission performance or, conversely, whether statistical field studies are a basic approach were matters argued inconclusively by the two camps represented by the two lightning papers. Initial strokes to high and low structures will be different, said F. C. Wagner and G. D. McCann (Westinghouse), and rates of rise should appear greater for charges disposed vertically on a high building than for horizontal distribution about a low structure; also shorter durations.

E. Hansson (Baltimore) feared that the papers decried the effectiveness of ground wires. McEachron held there was no evidence to show that initial leader strokes occur to lines of usual height. The most satisfactory correlation of information will result when current-time characteristics of a stroke are known, along with the complete wave shapes ensuing on the line, he said.

## Protection of Buses

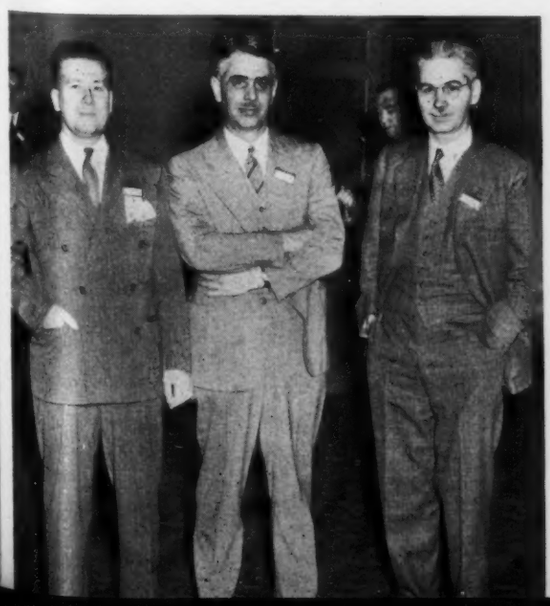
**Bus Protection Independent of Current Transformer Characteristics.** By **G. Steeb** (Buffalo, Niagara & Eastern).

Combination of high-speed directional ground relays on all sources of fault current and high-speed plunger type blocking relays on all outgoing circuits is independent of ratios and characteristics of current transformers. Total relay time one to two cycles. Installation has functioned correctly with large generator and power transformer section. Uses more relays but no additional current transformers. Mistake-proof. Secondary wiring troubles more likely to inhibit operation than cause incorrect operation.

**New Current Transformer for Bus Differential Protection.** By **L. F. Kennedy** and **A. T. Sinks** (both General Electric).

New air-gap core design maintains linear relation even with high currents completely offset. Core punchings altered at gaps to prevent local saturation of iron. Nonmetallic (textolite) material in gaps to

W. R. Spittall, Ferranti Electric; G. W. Lawrence and G. G. Waite, Sangamo Electric; S. H. Mortensen, Allis-Chalmers; W. P. Dobson, Hydro-Electric Power Commission; E. B. Paxton, General Electric; H. E. Farrer, A.I.E.E. staff



K. A. Hawley, Electric Power Equipment; W. B. Morton and C. F. Bishop, Philadelphia Electric; M. F. Skinker, Consolidated Edison; R. E. Jones, Hydro-Electric Power Commission, G. S. Van Antwerp, Philadelphia Electric; Prof. V. G. Smith, University of Toronto

insure mechanical stability under high currents. Electromagnetically shielded windings. Designed to give constant ratio up to 100,000 amp. Size and weight reasonable. Unaffected by d.c. component.

**A Simple Method for Determination of Ratio Error and Phase Angle in Current Transformers.** By **E. C. Wentz** (Westinghouse).

Method involves open-circuit saturation curve, secondary coil resistance and equivalent leakage reactance calculated from voltage of exploring coil inclosing maximum value of leakage flux. Details of procedure show simplified computations. Errors are on the conservative side. Can be used also for transient conditions, unusual burdens or currents (including paralleled transformers).

Feeling was expressed that the Steeb scheme is of limited scope. Prof. W. W. Lewis (Cornell) pointed to the one-point totalization of fault current as difficult for widely separated station elements, to the probable difficulties unless all feeders are strictly radial and to the inherent objection to a multiplicity of control contacts in series. L. F. Kennedy (General Electric) called the scheme an extension of carrier current pilot relaying and did not concede that the scheme was wholly independent of current transformer performance. Steeb, in closure, to a query about sticking contacts, said only about three a year of the 20,000 relays on the Niagara-Hudson system develop internal defects of a design nature.

In characteristic mood, H. P. Sleeper (Newark) recited the stages through which protective thinking had passed ever since it was discovered that bus faults seemed not to know they were not supposed to happen. He recalled multiple restraint circuits, d.c. components, harmonic restraint, generously proportioned transformers as the successive panaceas and now "we have come to linear characteristics of current transformers." It was "all very confusing" to him, yet he did not see the end of judgment in relaying decisions.

Fringing flux at multiplied gaps makes calculation of maximum flux density difficult and impracticable, said E. L. Harder (Westinghouse) and a somewhat similar gapped design was not offered because "a superior arrangement was devised." A. C. Monteith of the same company added that as long as there is ample energy to operate a reliable relay the output of the transformer is unimportant relative to the ratio of permissible through fault to setting.

## Simplified Switching

**Mechanical Simplicity of Air-Blast Circuit Breakers.** By **H. W. Haberl** (Montreal Light, Heat & Power) and **Otto Jensen** (I.T.E. Circuit Breaker Co.).

Reviews performance of air-blast breakers (4 to 230 kv.) of Canadian and U.S.A. makes. Gives schematic diagrams for each in several stages of operation. In twenty breaker-years of service there have been fifteen breaker interruptions and no failures. Operating times are 3 cycles or less from energizing of trip coil to current interruption, reclosure within 20 cycles.

**System Short-Circuit Currents.** By **W. M. Hanna** (Consol. Gas, Electric Light & Power), **H. A. Travers** and **C. F. Wagner** (both Westinghouse), **C. A. Woodrow** and **W. F. Skeats** (both General Electric).

Whether to adopt high-speed relaying and necessitate full interrupting rating of breakers or adopt slow-speed relaying and take advantage of short-circuit decrement

J. Leo Scanlon, J. Leo Scanlon Co.; J. Elmer Housley, Aluminum Co. of America; J. J. Costello, J. J. Costello Co. Convention Committeemen—F. F. Ambuhl (Hotels and Registration), Toronto Hydro; J. F. Neild (Transportation), Toronto Transportation Commission; M. J. McHenry (General Chairman), Hydro-Electric Power Commission; D. G. Geiger (Secretary) Bell Telephone of Canada; R. B. Chandler (General), Port Arthur P.U.C.

**R. T. Henry, Buffalo Niagara & Eastern; P. H. Adams, Public Service Electric & Gas; Bern Dibner, Burndy Engineering; C. F. Wagner and C. A. Powel, Westinghouse; F. H. Lane, Public Utility Engineering & Service; F. J. Meyer, Oklahoma Gas & Electric**

depends on the short-circuit current characteristics of a system. Paper gives practical curve method of approximation of fault currents with 2 to 8 cycle breakers and representative reactance valves for power systems. A series of specific rules is given for modification of basic values in applying the curves to systems with departures from assumed typical values. Method accords with trend toward high-speed relaying and eliminates the possibility of exceeding breaker interrupting capacities in modernizing the relay system.

**Power Circuit Breaker Ratings.** By **R. C. Van Sickle** (Westinghouse).

Proposes correlation of short-circuit ratings of breakers so that breaker selected on bases of Hanna paper will be adequate for other short-circuit currents. Prospect is that further simplification of that method can be obtained by rating a breaker on the initial value of the a.c. component of the short-circuit current which it can close, carry and interrupt.

Limitations of insulation for outdoor high-voltage air breakers would be likely to delay widespread adoption of them, J. B. MacNeill (Westinghouse) felt, and he lacked full confidence in large diaphragm valves. E. W. Knapp (Shawinigan) had faith that a complete range of voltages in air-blast breakers would be available before long. Jensen, in closure, said that the breaker which was seen by one observer to have the compressor running "one-third of the time" did actually run 23 hours out of 24 until completely installed, but now operates but two minutes an hour. He said the diaphragm valves are giving little trouble.

The committee report on short-circuit calculations was called by W. R. Brownlee (Commonwealth & Southern) unnecessarily conservative for two-shot operation in that it assumed most adverse time of initiation of the fault. Purchasers could make calculations of their own to determine whether the d.c. time constant at the breaker location warrants following the 9-cycle duration of the report. H. D. Braley (Consolidated Edison) said tests showed resistance of ground return paths caused 50 percent reduction in ground-current time-constant from that for typical three-phase fault values.

H. R. Summerhayes (General Electric) welcomed the reversion to the simplicity of the earlier days of breakers; nevertheless, he expects to see test specifications that will insure conformity with the stipulated margins of capability. J. A. Elzi (Commonwealth & Southern) feared that reliance on the initial a.c. component of fault current, as suggested in the VanSickle paper, might easily lead to misunderstanding in comparing breaker test performances. That latching current is occasionally less than the interrupting current rating was suggested by T. G. LeClair (Commonwealth Edison) as something not fully realized. In the case of a bus grounded for maintenance it may be that the breaker which closes is not the one which opens under fault. Skeats, in closure, agreed with MacNeill that it would be undesirable to sacrifice accuracy in breaker selection for extreme simplicity in calculating faults.

## Insulation Testing

**Impulse Strength as a Measure of Cable Quality.** By **L. I. Komives** (Detroit Edison).

Differs with accepted viewpoint in recommending maximum rather than average stress in evaluating results of impulse tests on cables. Negative wave favored. Correlates tests at Detroit and elsewhere. Breakdown of various impregnated paper-insulated cables occurs at 3,300 volts per mil maximum. "Solid, oil-filled, oilostatic and compression cables should all have the same maximum stress at breakdown." Oil-filled has advantage of intrinsically large conductor diameter. Service-aged solid cables show decrease in impulse strength. Oilostatic and compression types expected to retain original breakdown values. Although initially lower as to impulse strength than solid types, the low gas-pressure cables are expected to retain the value after service aging.

**The Basis for the Non-Destructive Testing of Insulation.** By **R. F. Field** (General Radio).

Analyzes literature and tests for existence of correlation between dielectric strength and low-frequency interfacial polarization. Any decrease in dielectric strength caused by deterioration can be measured by corresponding changes occurring in this polarization. New method of test segregates polarization in porcelain from that at cement-porcelain boundary.

**The A.C. Dielectric-Loss and Power-Factor Method for Field Investigation of Electrical Insulation.** By **F. C. Doble** (Doble Engineering).

Gives circuit principles of Doble field apparatus for measuring volt-amperes, watts and power factor of apparatus insulation. Shows control of effects of changing currents, of changes in phase angle and current caused by variations in capacitance and of extraneous electric fields by shielding and compensating networks. Concludes that 10-kv. test potential is adequate for equipment up to 287 kv. and avoids corona, portability, power consumption and voltage regulation disadvantages of higher voltage tests. Discusses collar tests and extension from bushing tests to large power transformers, generators and cables.

**The Protection of Solid Insulation by Lightning Arresters.** By **D. D. McCarthy** and **T. J. Carpenter** (both General Electric).

Investigates oil-immersed solid insulation of distribution transformers for puncture voltage and number of shots to failure of insulation paralleled with arresters or gaps to control wave shape of voltage applied to insulation. Repeated applications of voltages in excess of 70 percent of the single-shot puncture voltage may damage the insulation. Valve-type arresters found superior to 2-in. rod gaps for protection of insulation when subjected to

[*Continued on page* 115]

# Editorials

S. B. WILLIAMS, *Editor*

## *Civilian Defense Problems*

PLANS are developing rapidly for fashioning local civilian defense. It is a matter in which the electrical industry, particularly the utilities, is most interested.

Leaving out the matter of protection against sabotage, the direction of which, in fact, belongs with a different federal bureau, there are two phases to civilian defense which greatly concern utilities—blackouts and the enrollment of volunteer wardens and firemen.

Just as a great many children believe storks bring babies, so do lots of people believe that blackouts are the result of the pulling by the utility of a switch at the power house or substation. This belief presents an opportunity for the utilities to work with the Civilian Defense Administration to educate the public on its duties in a blackout, while telling why feeder switches cannot be pulled. Home service girls can be of great assistance in this work of public education.

In the case of employee home town defense enrollment the companies face a decision that unless properly handled might be misinterpreted. In civilian defense it is highly important that electric service be maintained. This will call for the training of non-operating male employees in emergency work. If these people are enrolled as wardens or firemen they will not be available for the company emergency service.

In the case of regularly employed operating people, such as line crews, power plant operators, dispatchers—there is no question but what these people will be much more valuable to civilian defense when they are at their regular posts than when acting as volunteer workers in their home towns.

Because of the excitement of a meeting many employees will feel that they should sign up for volunteer service without realizing the importance of their own work. Perhaps as a reminder to them, as well as a protection against influence, these workers might wear a "civilian defense—utility service" button, if there is such a thing.

At any rate, the enthusiasm of the moment must not be allowed to interfere with the maintenance of electric service under all emergency conditions.

## *Year-'Round Daylight Saving As a Power Conservator*

HOW MUCH would all-year-'round daylight saving reduce the December power peak and how many kilowatt-hours would it save? Nobody really knows. Estimates range all the way from zero to several percent. The reason nobody knows how beneficial daylight saving would be in the winter months is that there are too many variables.

In any region, for instance, the location of the property longitudinally makes a difference. A property at the eastern edge of a time belt will be affected differently from a property at the western edge.

There is also the dark day factor. Heavy clouds in December can change the time of peak, and daylight saving would have no effect whatsoever so far as saving capacity is concerned.

Then there is the matter of multiple shifts. As more factories go to two and three shifts the less effect will daylight saving have either on peak or consumption.

Arbitrarily to set some figure, such as 3 percent, and say that represents the saving in capacity or kilowatt-hours for year-'round daylight saving is liable to lead one into a position of expecting something that may never occur. It would be far better to undertake a study in a few centers that would present all of the variables. Then if a power saving were indicated and it was needed it could be put into effect with prior knowledge of the benefits to follow.

Until that is done daylight saving will remain as a doubtful factor in effecting a saving of power or kilowatt-hours.

## *Voltage Regulation Ahead of Distribution*

DESPITE the increased use of regulators and tap-changing forms of transformers there are still many lines in the 11-66-kv. class that rely on control of generator voltage. That has been a workable procedure so long as loadings were moderate and there was a comfortable margin of capacity to use in that way. Now, however, due to defense activities, loadings on transmission lines everywhere are rising above moderate levels.

Furthermore, the improvements in relaying, fault clearing, circuit breaker operation and lightning protection have had the result of enhancing the confidence of operators in the ability of line to take increased load. Elimination of localized bottlenecks, assignment of higher ratings to cables and conductors and terminal equipment have fostered the same trend from additional angles.

All these factors have conspired to create a new need for line and bus voltage regulation in the higher brackets of voltage. Emergency conditions here and there will justify a sacrifice of superlative voltage con-

ditions, but defense loads as a steady matter are going to need good voltage to get the most out of the utilization equipment.

Besides, any tendency to sanction poorer regulation on the transmission and intermediate-voltage links merely throws part of the task onto the substation and the distribution feeders.

In short, the whole trend of transmission reliability improvement, with excess loadings now superposed, seems to warrant as much thought to voltage regulation at and back of the substation as has been given to distribution in the form of more regulators, more capacitors and general capacity uplift in distribution.

## Shortened Terms

ONE THING the possibility of a reduced supply of appliances has brought about is shortened terms. For one reason or another the terms had drifted to such figures as nothing down and five years to pay. Now there is a general tightening on terms all along the line.

And what seems to surprise merchandise managers is that people don't seem to mind. They have the money, and if one insists they will pay whatever is necessary.

Allowances for trade-ins have also felt the effect of the market condition, and in some instances have disappeared. Wiring allowances, on the other hand, have not changed much, but probably will be reduced before long.

Thus the trend is to put the appliance business into a more sound condition, with fewer inducements and more cash as the supply becomes more restricted. People have the money now and will buy whatever volume is offered. Inducements are of less help to today's sales. They should be kept for the time when the supply is greater than the demand and money is not so plentiful.

## Promotion Must Be Maintained

BECAUSE of growing shortages of certain raw materials, principally nickel, aluminum and steel, there is every likelihood of some curtailment before long in the production of non-defense goods, among them electric appliances. The question now being discussed in Washington is whether to bring about the curtailment through inability to get raw materials or as the result of a direct reduction order, such as imposed on the automobile industry.

If and when this curtailment comes there will in all probability be an inclination on the part of some in the electrical appliance field to discontinue the national promotion programs. Such a move would be a mistake.

While it would be true that a national program could not increase sales one iota because there would not be enough appliances to satisfy the existing demand, it would be equally true that most of the sales efforts would be devoted to telling people why they could not have what they wanted—and that alone before long would begin to discourage people.

During this period ahead some agency must continue to sell the public on the electrical way. People must be made to want electrical equipment, even if they cannot satisfy that want at the time.

Then when the restrictions are removed there will be a huge pent-up demand to prevent the occurrence of any slump that otherwise might have followed. Today's selling, even if there is nothing to deliver, is one of the best preparations for the post-war period.

There are going to be lots of things that people with money to spend will not be permitted to buy. The money that they cannot spend will go into savings bonds and be available whenever they can get what they want. Manufacturers of other commodities are going to try to keep the prospect eager to buy. Electrical people cannot afford to do otherwise.

It will be too late to catch the first big post-war buying tide if promotion stops now, to pick up when the emergency is over.

## This Winter's Coal Supply

THOSE close to the fuel situation are becoming alarmed over the fall and winter coal supply and are doing everything they can to encourage users to buy now all the coal they can conveniently store.

In spite of the fact that industrial production has increased considerably, coal orders are only 1 or 2 percent greater than this time last year. In fact, some mines are not working at the present time because of lack of orders.

When the war broke out nearly two years ago the utilities, mindful of the coal situation during the last war, had fairly generally increased their coal storage. The average was around 60 days. Then when the coal mine strike threat came up this spring coal piles were increased to nearer 90 days. They have since come down to the 60-day level.

There is no shortage of coal production facilities, it is stated, because if necessary the mines can be operated longer hours. The difficulty, if any, is expected to come in transportation facilities, both rail and water. In spite of the fact that the railroads are confident that they can handle all the traffic this fall, it might be good policy for large coal users further to insure their operation by an additional thirty days' supply of fuel.

The matter of money is not as important as it once was because, as one operator expressed it: "I would just as soon have my money invested in fuel as lying around in the bank."

This is just another of those precautions that can be taken to insure service continuity—and it wouldn't hurt to let the public know it was being done.

# How Power Shortages Are Built

By CARTER FIELD

**This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him**

REMEMBER the Marx brothers as amateur detectives, trying to solve a murder mystery?

"Maybe it was somebody from the house next door," said Groucho.

"But there isn't any house next door," retorted Chico.

"No?" said Groucho, "then we got to build one."

Whereupon the zanies became enthusiastic—drawing plans—figuring where to put the dining room, etc. The murder was forgotten completely.

It's sort of like this electric power shortage. There wasn't one—not during all these New Deal years, when, as regularly as appropriation time rolled around, there were dire predictions to speed money for new dams to spread the domain of public power.

There isn't one yet, except temporarily in the Southeast, where a drought plus aluminum demand for airplanes has forced some rationing. But there's going to be a real one for the simple reason that we are going to build it. Maybe, in fact probably, it is an intelligent thing, in view of the world situation, but the Administration has not taken Congress, much less the public, into its confidence about it.

### *The Philosophy of Shortage*

This building of a power shortage is precisely the opposite extreme from budget planning. Under a budget a person figures out carefully in advance just what is necessary, how much it will cost—what that will leave for luxuries. Theoretically a government does the same sort of thing—or did in the good old days.

But this electric power shortage building is not like that at all. It is precisely like the delightful fictional story of the man who had to spend a million dollars in a very short period—or else. The question is not where to save, but where to spend.

Mr. A tells the Administration 100,000 kw. can be produced at Squedunk.

"Unfortunately," he adds, being an honest man, "there is no market for the power in that vicinity."

"Never mind that," says the Administration. "Have that plant producing power as quickly as possible. We will put some defense industry there and have it waiting for the power by the time you can deliver it."

"But Congress has not appropriated any money to take care of this additional spending," he may protest.

"You get the power—we will attend to that," is the answer.

The present philosophy of the Administration is that there is not enough of anything—with the possible exception of wheat; that there will not be enough of anything in 1942, and that there will not be enough of anything in 1943. This is not an exaggeration. It is an understatement. Actually on the electric power front the Administration is thinking much further ahead than that. Four years is about the minimum on St. Lawrence Seaway power, even in New Deal optimistic calculations, and that would take us to 1945. More accurately, to 1946, because there is no hope of starting construction—or certainly of getting legislation to authorize it, before September.

Of course the public power bloc in the Administration is delighted with the opportunity which this program, or philosophy, affords, and intends to take the fullest advantage of it. But that is not quite the entire picture. For example, Harold L. Ickes is reported to be very much annoyed that the Federal Power Commission has granted licenses to the Pacific Gas & Electric Company for dams at Cresta and Pulga, on the Feather River. A House committee had knocked out Harold's plans for a government steam plant to supplement the Central Valley hydro project, on the assurance of Pacific Gas & Electric that it could supply the necessary supplemental steam power.

But the end is not yet. Harold has by no means given up hope for that steam plant, and betting odds are heavy that he will get it before this session of Congress ends. Never forget the policy—all of everything we can get, regardless of expense, regardless of sound economics, regardless of everything but the national emergency.

Moreover, the public power boys were not defeated 100 percent even on those Cresta and Pulga dams. The licenses were granted for 35 years instead of the usual 50 years. Add up all the strings which a federal power license puts on a privately owned dam and you just might detect an aroma somewhat reminiscent of Munich.

### *Give a Look*

Meanwhile, let's look just a minute at that Southeastern situation—the only one in the country where the pessimistic predictions of the public power advocates seem to have been justified.

In the first place, every one will remember that the Aluminum Company has been blocked by the public power crowd for years from constructing hydro projects it desired in this region. Now, with the terrific military necessity for more aluminum for airplanes, it would never do for the country to realize that this policy was responsible for a great military weakness. So, although the Aluminum Company has only a firm contract for 30,000 kw. with TVA, the TVA is supplying this one time whipping boy of the Administration 150,000 kw.! Not only that, but it is rationing its other customers, and draining its reservoirs at a rate considered dangerous to do it!

It so happens that the greatest shortage of all is in ships. It takes three tons of bauxite to make one ton of aluminum, and much of our bauxite comes from Georgetown, British Guiana. We can't spare ships to take this ore all the way up to Portland, near Bonneville power. It must be worked in the Southeast. So, having starved aluminum in the interest of public power, we must now feed aluminum in the interest of national defense!

That's the answer to the power shortage in the Southeast!

# NEWS OF THE WEEK

## Two Utilities Order New Units for Steam Plants

***Alabama Power Co. to install 60,000-kw. turbo-generator in Gorgas station and Cleveland Electric Illuminating Co. plans 50,000-kw. addition to its Avon power plant — General Electric gets orders***

Orders for two generating units totaling 110,000 kw. were placed late last week by two large utility companies—Alabama Power Co. and Cleveland Electric Illuminating Co.—to insure a plentiful supply of electric power to meet normal and expanding defense needs of industry.

Alabama Power Co. has made application to the state Public Service Commission for a certificate to construct a second 60,000-kw. unit in the Gorgas No. 2 steam plant in Walker County to be ready for operation May 1, 1943. President Thomas W. Martin pointed out that the company now has two large steam plants at Gorgas, one which contains three units with a total of 70,000 kw., the other which contains one 60,000-kw. unit. It is at this second plant that the new 60,000-kw. unit, ordered from General Electric Co., will be installed. There is space in this plant for four units.

### *100 Percent for Defense*

President Eben G. Crawford of Cleveland Electric Illuminating Co. stated that the company had ordered an additional 50,000-kw. turbo-generator for installation at the Avon power plant. The unit, which has been ordered from General Electric Co., together with accessory equipment and the construction of an addition to the present power plant building, will cost approximately $3,500,000.

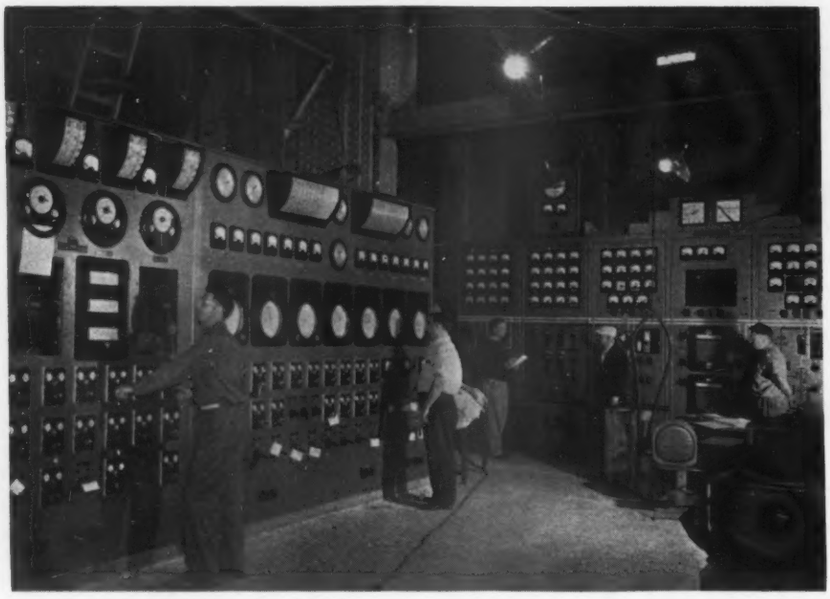
"This project is 100 percent for national defense," Mr. Crawford said. "By placing our order for this generator now we are attempting to put ourselves in the best possible position with respect to priority on delivery."

It was pointed out by Mr. Crawford that the present facilities of the company are entirely adequate to meet all demands for power anticipated presently, and additional facilities now under construction will take care of future demands as they are expected to develop in the next couple of years. The new unit is scheduled for operation in the fall of 1943. At present the company has under construction two generators, with a total dependable capacity of 144,000 kw., for installation at its Lake Shore power plant. The first will be installed this summer and the second next spring.

### *Spending $13,300,000*

Cleveland Electric Illuminating Co. this year is expending for construction of new facilities approximately $13,300,000, the major projects being the additional generating capacity at Lake Shore power plant and substations with transmission and distribution lines to serve defense industries. The Cleveland Chamber of Commerce estimates that direct government orders for defense products and loans for defense plant construction placed with concerns in

**STARTS SUBSTATION—K. C. Long, vice-president of Dayton Power & Light Co., breaks ground for the company's new 50,000-kva. Webster Street substation and link in a new 66-kv. transmission ring around Dayton. With him are (l. to r.) P. K. Pfanner, I. C. Eppley, William Shuler, J. M. Stuart, A. B. Crouse, K. G. Oxley, L. A. Bryant and O. B. Reemlin**



**OSWEGO STATION—Section of the main control room at the new Oswego steam-electric generating station of Central New York Power Corp., Niagara Hudson Power System. At left is the boiler panel for the first unit and at right is the turbine and generator panel for both units. The second 80,000-kw. General Electric turbo-generator is now being installed and will go into service this fall**

metropolitan Cleveland up to June 1, 1941, totaled $328,108,785. In addition several millions of dollars of indirect contracts for defense products have been received.

Mr. Martin said that General Electric has promised delivery of the Gorgas unit in the early part of 1943, in time for completed installation to be ready for operation by May 1 of that year. The unit will operate at 3,600 r.p.m. and steam will be at 850 lb. It will require a boiler capacity of 600,000 lb. of steam per hour. The boiler will burn powered coal and at full load the new unit will use 700 tons of coal per day. Orders for the boiler and condenser have not as yet been placed.

The additional generator is the third large unit ordered by the company within the past eighteen months, at a total installed cost of about $11,000,000. The first was a 40,000-kw. unit for the new Chickasaw steam plant, near Mobile, which went into operation several weeks ago, and a second 40,000-kw. unit for the same plant scheduled for operation by January 1, 1943.

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## Union Opposes City Ownership of Utility

Opposition to the proposal by Councilman Herbert S. Bigelow for municipal ownership of Cincinnati Gas & Electric Co. facilities was unanimously expressed by the CIO gas workers of the utility at a recent meeting.

The union, Local 12,049, United Mine Workers, adopted a resolution stating that a contract with the company in behalf of 650 gas workers had been signed granting pay increases and better working conditions and that it was exercising all its rights under private ownership of the utility.

The resolution added that the union is "vigorously opposed to change at this time" and urged the Council to vote down the municipal ownership proposal.

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## Philadelphia Rate Cut Approved

Pennsylvania Public Utility Commission has accepted an offer of the Philadelphia Electric Co. to reduce its rates to consumers about $4,000,000 a year and issued an order to this effect operative September 1. The commission pointed out that, although it has terminated the rate case, the commission will continue its study of the company's financial set-up and will study the reasonableness of the new rates. The commission has the right to institute new formal rate proceedings against the company at any time it may consider such action necessary, according to the commission's statement.

The order terminated a rate study which the commission instituted on its own initiative last November. Officials of the company said that pending study of the commission's order no detailed breakdown of the savings which will accrue to individual consumers could be made public.

# NEWS BRIEFS

ELECTRICITY IS TANGIBLE personal property, so says Judge Walter B. Jones of Montgomery, Ala., and in his decree the state must dig into its coffers and refund $1,733 in taxes levied on machinery for producing power of the Alabama Power Co. Electricity is composed of particles of matter "infinitesimally small" which nevertheless are as tangible as articles that can be handed from one person to another, says Judge Jones.

TVA HAS CLOSED the highway atop Wilson Dam in Alabama to general traffic as part of the President's proclamation of an unlimited emergency. Only TVA cars and trucks and buses on regular routes will be allowed to pass.

BONNEVILLE HAS BEEN DENIED the $130,000 added by the Senate for marketing development by the House and Senate conferees on the Interior Department appropriation bill.

A SURE FIRE PROOF that people are interested in better living was seen when Commonwealth Edison Co. on June 1 closed the doors permanently to its Home for Electric Living after recording a total of 702,733 persons from every state in the country and several foreign countries as having viewed its advantages since it was opened June 1, 1939.

A TRENCH-LAY CABLE installed by an industrial plant failed as soon as it was energized. Over-conscientious workmen had nailed the overlying protective plank to the cable for extra assurances. No one spiked the rumors.

ELECTRIC RANGE installations on the Twin State and Central Vermont Public Service systems, by utilities and dealers, totaled 226 in a recent summary for 1941 to date, exceeding any previous year and gaining 40 per cent over 1940. In two weeks 346 electric refrigerators went on the lines, making the period total 981, a new record. Attendance at electric cooking schools is passing former figures in the Green Mountain State.

AN EDITORIAL in the Oregon *Journal* says "the Northwest Public Power Association, made up of the principal municipal systems and operating PUDs of Oregon and Washington, wants no part of Harold L. Ickes' program to establish a power dictatorship with Harold L. Ickes in control. The association wants an independent Columbia power authority, completely divorced from Secretary Ickes' Interior Department, and with local representations, and requirements for self-liquidation."

# Electrical Manufacturers Form Liaison Committee

***Group of twenty-four representatives named by OPM to work out defense problems — Committee will act as clearing house and effect greater spread of government purchases***

A 24-man committee representing small and large units of the electrical manufacturing industry has been named by the Office of Production Management to provide continuing liaison between the government's defense arm and industry. The committee is part of a general program stretching into all industry to streamline government-business co-operation for defense.

The committee is the outgrowth of the meeting called by OPM of more than 60 manufacturers some weeks ago at which the growing problems of procurement, priorities and production were discussed.

### *Act as Clearing House*

Under the new setup the committee will act as a clearing house for bringing to the attention of both the industry and OPM each other's problems. These will include the working out of "temporary" modifications of federal specifications to permit use of substitutes, conservation and substitution of materials, simplified practices, allocation of production capacity and standardization of production, wherever possible and practical.

Another paramount subject for committee attention will be efforts to get greater spread of government purchases. The objective is to take some of the burden off larger manufacturers by increased subcontracting and by getting small plants to take on more direct orders.

Prior to setting up the committee, the anti-trust legal aspects of this form of voluntary industry co-operation with government were scrutinized by OPM's legal staff and laid before Attorney-General Jackson for clearance.

From the committee of 24 members six have been designated a steering committee to work with Donald G. Clark, chief of the equipment and supplies branch of OPM's Procurement Division. The steering committee members are W. J. Donald, managing director National Electrical Manufacturers Association; Leonard Kebler, president Ward, Leonard Electric Co., Mount Vernon, N. Y.; J. P. Shelley, president Metropolitan Electric Manufacturing Co., Long Island; W. E. Sprackling, vice-president Anaconda Wire & Cable Co.; George Thomas, Jr., president Thomas & Betts Co., Elizabeth, N. J.; George F. Hessler, sales manager Graybar Electric Co., New York.

The eighteen other members of the full committee are:

H. E. Blood, president Norge Division, Borg-Warner Corp., Detroit; C. L. Collens, president Reliance Electric & Engineering Co., Cleveland; Frederick Eisman, secretary-treasurer Revere Electrical Co., New York City; Ralph Kelly, vice-president Westinghouse Electric & Manufacturing Co., New York; Leslie E. Latham, president E. B. Latham & Co., New York City; F. W. Magin, president Square-D Co., Detroit; Robert W. McChesney, president National Electrical Contractors Association, Washington; J. W. McNair, electrical engineer American Standards Association, New York City; Everett Morss, Jr., president Simplex Wire & Cable Co., Cambridge, Mass.; John M. Newton, president Oakes Electric Supply Co., Holyoke, Mass.; Matthew Porosky, vice-president Eagle Signal Corp., Boston; A. C. Prange, supply sales manager General Electric Supply Corp., Bridgeport, Conn.; C. A. Scott, vice-president Rome Cable Corp., Rome, N. Y.; E. O. Shreve, vice-president General Electric Co., Schenectady, N. Y.; D. M. Simmons, vice-president General Cable Corp., New York; Paul J. Smith, American Society for Testing Materials, Philadelphia; C. E. Swartzbaugh, president Swartzbaugh Manufacturing Co., Toledo, Ohio; Walter Williamson, vice-president Westinghouse Electric Supply Co., New York City.

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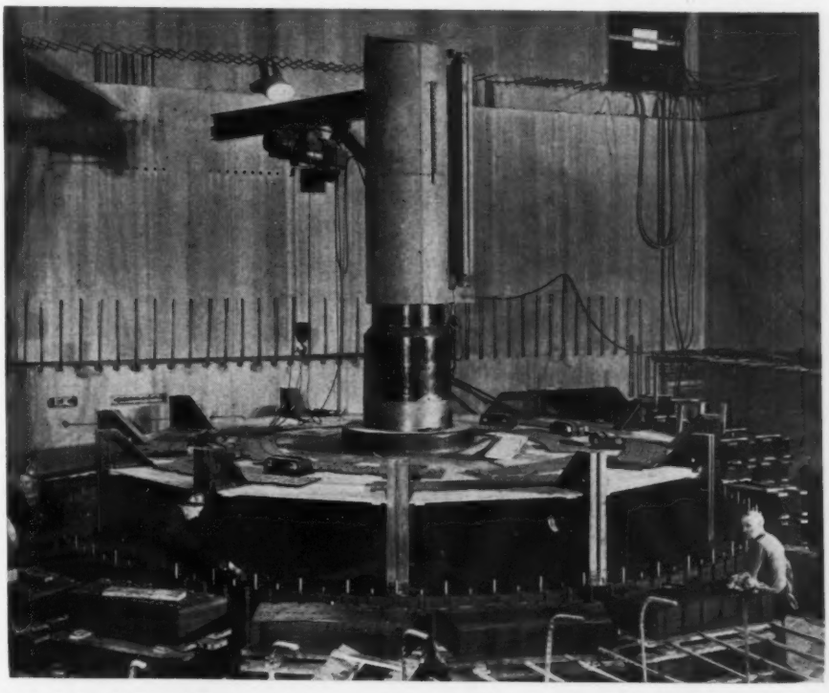
## Columbia River Bill Puts Ickes as Head

Secretary Ickes' new Columbia River Authority legislation reached Congress this week. The bill, introduced by Congressman Hill, Washington, is understood to have been drafted by Abe Fortas, chief of Ickes' power division.

The bill provides for a single administrator of the Grand Coulee-Bonneville power pool, with two assistants, under the supervision of the Secretary of Interior. Also set up is an advisory council of six members, all residents of the Northwest, to advise and consult with the administrator.

Authority is given the agency to purchase, lease or condemn existing utility properties and to issue up to $200,000,000 in notes or bonds at any one time for this purpose.



**FIRST OF THREE—Work is being rushed on the first of three 108,000-kw. generators at Grand Coulee in an effort to assure operation early in August to alleviate a potential summer power shortage brought on by deficient rainfall throughout the Pacific Northwest. Here workmen are stacking iron for the rotor core. The machines are the largest waterwheel generators ever built**

# Presents Plan to Meet Integration Provisions

***President Whiting outlines to Commonwealth & Southern stockholders a method to solve proceedings before SEC and to reduce operations to single integrated geographic system***

Breakup of the giant Commonwealth & Southern system to comply with the integration provisions of the utility act will be carried out with the sale of the northern properties and retention of the southern companies should SEC approve the plan now under discussion and outlined to stockholders at the annual meeting last week.

President Justin R. Whiting informed stockholders of the proceedings now before SEC and the attempts of the corporation being made to meet the problems. So far the SEC has ordered the corporation to simplify its corporate structure and reduce its outstanding securities to a single class of common stock; that operations be confined to a single integrated system, and that the service organization should not bear any expenses of the parent company.

### *Action to Preserve Rights*

"In all of these proceedings," Mr. Whiting said, "we have taken all action we were advised to be necessary to preserve all the legal and constitutional rights of the corporation, its subsidiaries and its stockholders." He said that the corporation is attempting to work out with the commission a solution of the problems.

Under consideration at the present time is the possibility of disposing of the issue in all of the proceedings before the SEC by the liquidation of the preferred stock of Commonwealth & Southern by distribution of shares of common stock in Consumers Power Co., Central Illinois Light Co., Ohio Edison Co. and Pennsylvania Power Co.

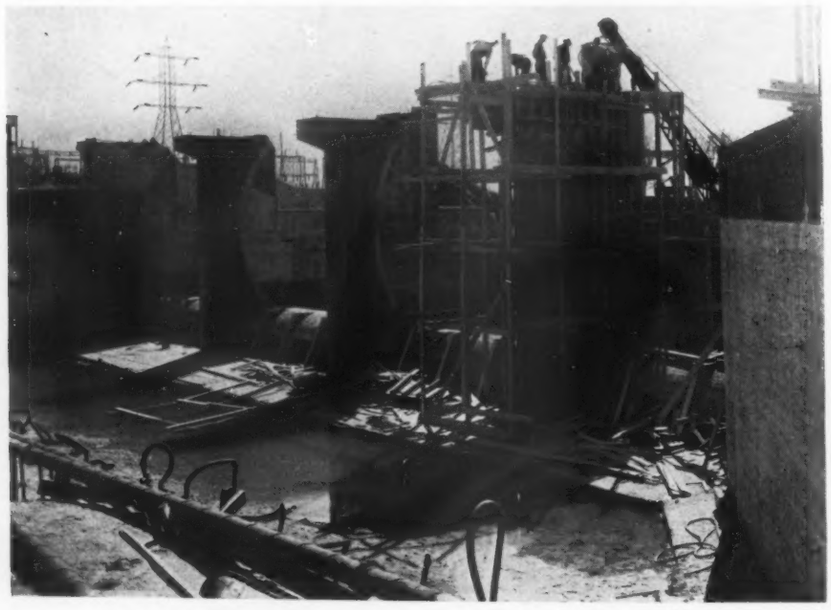
"It is expected that if this is worked out," Mr. Whiting said, "the mutual service company, the stock of which is now owned by the operating subsidiaries, would be reorganized into two separate companies so that the companies whose stocks are distributed would own a separate service company which would take over their service contracts with personnel from the present service company."

Mr. Whiting said that "we believe we will be able to prove that our southern group of companies, Georgia Power, Alabama Power, South Carolina Power, Mississippi Power and Gulf Power companies, constitute an integrated system and could continue to be owned by the corporation."

The disposal of the northern properties would be contingent upon SEC approval and arrangements with respect to the recently contracted $17,000,000 bank loans be made satisfactory to the lending banks.

Last week SEC ruled adversely on the question of the admissibility of expert opinion on the valuation of securities of Commonwealth & Southern. The corporation sought to show that its holdings had value and earning power sufficient to support its present corporate struction.

The readiness of Commonwealth & Southern to comply with provisions of the utility act left only Engineers Public Service Co. as the only major utility system to stand firm against the "disintegration" rulings of the SEC. The company has given no indications that it had wavered in its stand that the law allows for retention of more than one integrated system.



**MORROW PLANT ADDITION—Recent picture showing construction at the Bryce E. Morrow plant of Consumers Power Co. outside Kalamazoo, Mich., where a new 50,000-kw. General Electric turbo-generator is being added. The plant is scheduled for completion next September. The view is of the spillway for a ¾-mile wide dam to stabilize flow of cooling water. It will form a lake of 800 acres**

## PUD Defeat Seen Trend from Public Ownership

Defeat of the proposed Baker county PUD by a 3 to 1 vote at a special election May 27 is receiving special attention. Coming on the heels of the Clatsop County PUD vote, where a public ownership proposal was rejected on May 6, the Baker County result was viewed as indicative of a trend against embarking upon such ventures in the face of the national defense emergency.

Vote in the Baker election was 808 yes and 2,393 no votes. The city vote was overwhelmingly against the PUD, 2,005 to 547. Bulk of the area is served by the East Oregon Light & Power Co., with headquarters in Baker.

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## Grove Named Chairman

W. A. "Art" Grove, advertising manager, Edison General Electric Appliance Co., has been elected chairman of the plan committee of the Modern Kitchen Bureau for 1941-42. Roger Bolin, manager, merchandise advertising and sales promotion, Westinghouse Electric & Manufacturing Co., will be vice-chairman.

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## Seeks TVA Expansion

A Nashville, Tenn., delegation headed by Mayor Thomas L. Cummings has conferred with TVA officials on possible expansion of TVA in middle Tennessee. Nashville is interested in development of the Cumberland valley and construction of a steam-electric generating plant by TVA near Nashville.

## St. Lawrence Backers Give Project Views

A parade of government officials has been passing in review before the House rivers and harbors committee during the past two weeks as part of the strategy of the Administration to whip up support for construction of the St. Lawrence seaway and power project as a defense measure. The heavy political guns roared as the committee was bombarded by Secretary Knox, Governor Lehman of New York, Assistant Secretary of State A. A. Berle, Jr., Admiral George H. Rock, U. S. N., retired; Secretary of Commerce Jesse H. Jones, Brig.-Gen. Thomas M. Robins, assistant chief of Army engineers, and a host of others in support of the project. OPM announced its support as did Governor Edison of New Jersey.

Premier Mitchell F. Hepburn of Ontario, during a stop in Ogdensburg, N. Y., as a guest of the Detroit Chamber of Commerce on its annual river cruise, indorsed the plan.

While proponents of the projects were having their day opposition forces were gathering their witnesses for a concerted attack when their turn came to appear before the congressional committee. Western New York interests, particularly the Buffalo Chamber of Commerce and the Port of Buffalo Defense Committee, rallied forces for a concerted attack against the seaway and power project.

The tenor of the support for St. Lawrence is that the war may last many years and that the project should be completed as soon as possible as a national defense measure. Proponents point out that power to be generated is needed by defense industries and that the seaway would aid navigation and open new shipbuilding sites.

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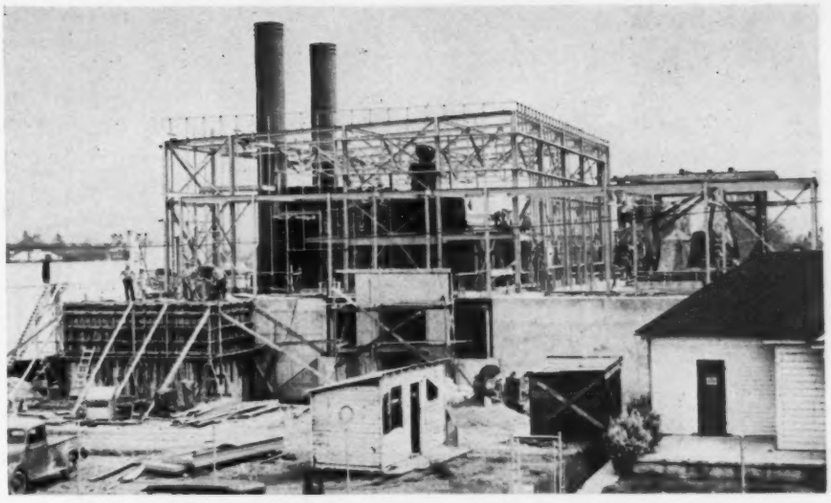
## OPACS Moves to Stop Refrigerator Price Rise

OPACS this week requested sixteen manufacturers producing 97 percent of household refrigerators not to make additional increases in prices without prior consultation with the agency. The request, of course, is backed by Leon Henderson's authority to impose price ceilings if not complied with.

In requesting no further increases, OPACS also disclosed that it is now studying recent upward trends of refrigerator prices to determine their justification. Justification of new price increases under prevailing OPACS policy is generally possible only by showing specific increases in costs. Even then the increase must be limited to the actual additional cost; it cannot be a percentage markup.



**TWO NEW UNITS—Two 10,000-kw. Allis-Chalmers steam turbo-generators are being installed in this modern station for the Burbank (Calif.) Public Service Department to meet unprecedented load growth brought on by defense industries, especially aviation**

## Kellogg Quits OPM; Krug Named to Post

Charles W. Kellogg, president of the Edison Electric Institute, has resigned as chief consultant on electric power of the Office of Production Management because of a rule against employment in the OPM of trade association officials. J. A. Krug, manager of power for the TVA, is to replace Mr. Kellogg, who joined the National Defense Advisory Commission staff on June 13, 1940. He joined OPM when it was formed in January, 1941.

Mr. Krug was headed for OPM before the resignation of Mr. Kellogg. He was to have been "loaned" to the agency to find means of pooling enough power quickly to provide for needed aluminum and magnesium production capacity.

Mr. Kellogg resigned in compliance with a new, and unannounced, policy adopted by OPM only last week making trade association officials ineligible for employment as members of the defense agency.

In a letter to William S. Knudsen, director-general of OPM, Mr. Kellogg stated that he had been advised by William S. Batt, deputy production director, of the new regulation. "Under your leadership," Mr. Kellogg wrote, "my year of service has been a pleasure and a satisfaction, and I trust you will call upon me at any time in the future for such advice or assistance as you may feel I can give to the defense effort, which you are forwarding with such conspicuous ability and devotion."

At the E.E.I. convention in Buffalo Mr. Kellogg pointed out that there would be no power shortage as the electric utilities were installing more than 7,500,000 kw. of generating capacity in 1941 and 1942 and that an additional 670,000 kw. would be installed by factories which supply their own power. Secretary Ickes took sharp dissent from this statement and later the OPM in an official statement, approved by Mr. Knudsen, said that Mr. Kellogg was expressing his own private view and not that of OPM.

With the E.E.I. president's departure, Mr. Krug was given a full appointment to OPM's staff and it is understood that he may be selected by the President as national power "co-ordinator"—an obvious middle-ground step between Secretary Ickes, who is campaigning for the post, and Federal Power Commission Chairman Leland Olds.

•

## Tells Customers to Use All Power They Desire

Nebraska Power Co., in a full-page advertisement, advises customers that "we have plenty of electricity for all our customers' needs." The company points out that there is no shortage of electricity in the territory served and that there is 50 percent more electricity available in Nebraska than there was a year ago, "and last year's power supply was more than sufficient to meet the power requirements of our customers."

The company is telling its customers to use all the electricity needed for any purpose desired and there is plenty for any additional requirements of national defense.

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## New Power Project

A new power development of 700,000 hp. is being established on the Saguenay River in Quebec for use of the Arvida aluminum plant.

## Cuts Time Payments on Appliance Sales

Curtailment of installment selling to reduce consumer purchases stimulated by the defense program became active last week in the utility appliance field when Consolidated Edison Co. of New York revised the financing terms applying to all gas and electric appliances under the company's three-year co-operative plan.

At the same time General Electric Company's contract division initiated a campaign to encourage dealers to reduce maximum payment time to thirty months from thirty-six.

E. F. Jeffe, vice-president of Consolidated Edison, stated that the action taken by his company is in line with the federal government's policy regarding curtailment of installment selling in view of the present emergency and the needs which may develop for national defense. The company's new plan calls for a reduction of the maximum period for time payments from thirty-six to twenty-four months and for larger initial down payments. The principal items in this category are refrigerators and ranges. Installment period on other appliances has been reduced from twenty-four to twelve months.

It was pointed out by Mr. Jeffe that it is better for retailers and manufacturers to take the initiative in adjusting themselves to the basic changes in merchandising methods which are likely to take place as a result of present conditions. "We are glad to be among the first in this territory to take decisive steps toward complete co-operation with the government in its efforts to prevent inflation and solve the greatly accentuated problems of priorities and deliveries," he said.

•

## Adopts Defense Tax

Electric, water and bottled gas consumers in Dothan, Ala., will start paying a special defense tax of 5 percent on their monthly bills when the July accounts become due under an ordinance enacted by the City Commission. The ordinance will be in force until a $70,000 indebtedness, incurred by the city in its joint purchase with the county of 1,500 acres to be used as an Air Corps pilots' school, is paid.

•

## Sells Distribution System

The Lower Colorado River Authority has sold the distribution system in Brenham, Texas, to the city for a consideration of $306,590. The authority has sold the plant and distribution system of Giddings to the city. The LCRA, which constructed and operates the four large flood control and power dams on the Colorado River, retains ownership of the extensive transmission systems in more than eighteen counties of the Austin area.

•

## Billion Kw.-Hrs. Lost

The eastern portion of the United States lost a billion kilowatt-hours of needed hydro-electric power during May, the geological survey reported, because of drought-shrunk streams. The energy lost was equal to 40 percent of the hydro power generated in the area in May, 1940.

•

## Purchase Utility System

Plans have been completed for the Cumberland Electric Membership Corp. to purchase the properties of the Tennessee Light & Power Co. for $170,000. This is part of a $350,000 REA loan, the remainder to be used in building new lines and repairing old ones.

•

## Installs New Unit

Board of Public Works, Grand Haven, Mich., has announced that a new 3,850-b.hp., nine-cylinder, 21½-in. bore x 31-in. stroke Nordberg Diesel engine with 6,900-volt Allis-Chalmers generator is being installed at the municipal electric plant.

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## Utility Law Signed

Gov. Murray D. Van Wagoner of Michigan has signed and enacted into a law a measure which declares it a felony to destroy maliciously the properties of public utility companies.

# MEETINGS

**Michigan Electric Light Association**—Annual convention, Grand Hotel, Mackinac Island, Mich., June 30-July 2. C. H. Silvester, secretary, Port Huron, Mich.

**International Association of Electrical Inspectors**—Southwestern section, Hotel DeAnza, San Jose, Calif., August 25-27. H. L. Gerber, secretary, Room 205, City Hall, San Francisco, Calif.; northwestern section, Winthrop Hotel, Tacoma, Wash., September 2-5. F. D. Weber, secretary, P. O. Box 70, Portland, Ore.; western section, Hotel St. Paul, St. Paul, Minn., September 8-10. F. H. Moore, secretary, 320 N. Meridian St., Indianapolis, Ind.; eastern section, Mayflower Hotel, Washington, D. C., September 22-24. F. N. M. Squires, secretary, 85 John St., New York, N. Y.; southern section, McAllister Hotel, Miami, Fla., September 29-October 1. Joseph Whitner, secretary, P. O. Box 1743, Atlanta, Ga.

**American Institute of Electrical Engineers**—Pacific Coast convention, Yellowstone National Park, August 27-29. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

## Arkansas Power Denied Blakely Dam Rehearing

Federal Power Commission has denied the application filed by the Arkansas Power & Light Co. for a rehearing on the commission's order of May 3 relating to the license covering the Blakely development of the company's Project No. 271 on the Ouachita River in Arkansas. The order states that no sufficient reason has been shown by the applicant for reconsideration of the matter nor has any new evidence or showing been made which would justify reversal of the previous order.

Effective date for termination of the license, so far as it pertains to the Blakely development, is September 1, 1941.

•

## Commission Approves REA Loan for New York Utility

New York State Electric & Gas Corp. has been authorized by the Public Service Commission to sell the REA a 20-year serial note for $500,000 to finance the construction of 453½ miles of additional lines to serve farm customers. The note is to be paid in thirty-nine equal semi-annual installments, with interest on the unpaid balances at the rate of 2.46 per cent.

This is the sixth REA loan for the utility, the five previous ones totaling $1,745,000.

•

## Board Cancels Hearing

Federal Power Commission has approved the reclassification of electric plant accounts and disposition of certain amounts submitted by the Peoples Power Co. of Moline, Ill., in adjusting its proposed reclassification and original cost studies required by Electric Plant Accounts Instruction 2-D of the commission's uniform system of accounts. As a result of this approval the commission's show cause order is dismissed and the public hearing previously set to begin on June 23 is canceled.

•

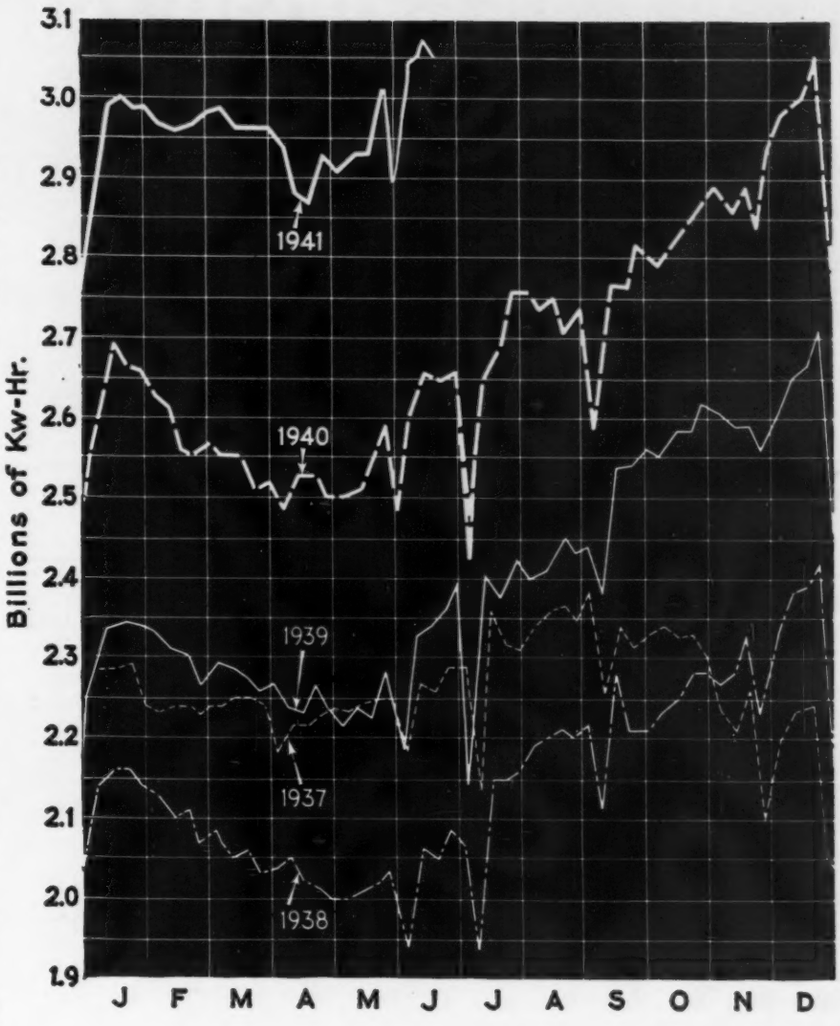
## Asks Power Saving

Weather conditions effected a water shortage in another section of the world recently—this time in New Zealand—when, owing to a water shortage at a generator point, a peak-load shortage was foreseen and eight suburbs of Wellington were cut off for three hours. Electricity Controller Kissel has told the nation again that economy of electric power must be practiced because of mounting demand or sections of the country will be cut off in turn.

## Energy Production Shows Slight Drop

Power production for the week ended June 21 showed a slight decrease from the preceding week as curtailment of use for non-essentials was practiced throughout the drought-stricken Southeast. Output for the week was 3,055,841,000 kw.-hr. a decrease of 0.3 percent from the week before, but 15.2 percent above the same week last year, according to report of the Edison Electric Institute.

The figures for the week ended June 14 were revised by the Institute, making the total 3,066,047,000 kw.-hr., against 3,057,344,000 kw.-hr. as previously reported. The percentage change over last year in the Southern States was revised from 14.4 percent to 16.0 percent and the total for the country was changed from 14.7 percent to 15.1 percent. Only three geographical regions showed greater gain over a year ago than reported the week before.




**Weekly Output, Millions Kw.-Hr.**

| 1941 | | 1940 | | 1939 | |
|---|---|---|---|---|---|
| June 21 | 3,056 | June 22 | 2,654 | June 24 | 2,362 |
| June 14 | 3,066* | June 15 | 2,665 | June 17 | 2,340 |
| June 7 | 3,042 | June 8 | 2,599 | June 10 | 2,329 |
| May 31 | 2,924* | June 1 | 2,478 | June 3 | 2,186 |
| May 24 | 3,012 | May 25 | 2,589 | May 27 | 2,278 |
| May 17 | 2,983 | May 18 | 2,550 | May 20 | 2,235 |
| May 10 | 2,975 | May 11 | 2,516 | May 13 | 2,239 |
| May 3 | 2,915 | May 4 | 2,504 | May 6 | 2,225 |
| Apr. 26 | 2,926 | Apr. 27 | 2,499 | Apr. 29 | 2,244 |
| Apr. 19 | 2,874 | Arp. 20 | 2,529 | Apr. 22 | 2,265 |
| Apr. 12 | 2,882 | Apr. 13 | 2,530 | Apr. 15 | 2,235 |

**Percent Change from Previous Week**

| | Week Ending | | |
|---|---|---|---|
| | June 21 | June 14 | June 7 |
| New England | +22.0 | +21.6 | +25.1 |
| Mid-Atlantic | +16.4 | +12.9 | +19.2 |
| Central Industrial | +19.7 | +20.3 | +22.2 |
| West Central | +11.9 | +14.3 | +11.5 |
| Southern States | +14.8 | +16.0* | +15.8 |
| Rocky Mountain | + 8.4 | +10.0 | +12.3 |
| Pacific Coast | + 4.0 | + 3.9 | + 4.2 |
| Total United States. | +15.2 | +15.1* | +17.1 |

* Revised.

## Sales and Revenue Show Gain Over 1940

Power production, sales, revenue, average use and customer revenue have shown a consistent increase over last year for the first three months this year, according to report of the Edison Electric Institute.

In January generation was 13,640,831,000 kw.-hr., against 10,066,530,000 kw.-hr. in the same 1940 month. February generation was 12,293,168,000 kw.-hr., against 11,107,146,000 kw.-hr., and for March it was 13,384,486,000 kw.-hr., against 11,514,728,000 kw.-hr.

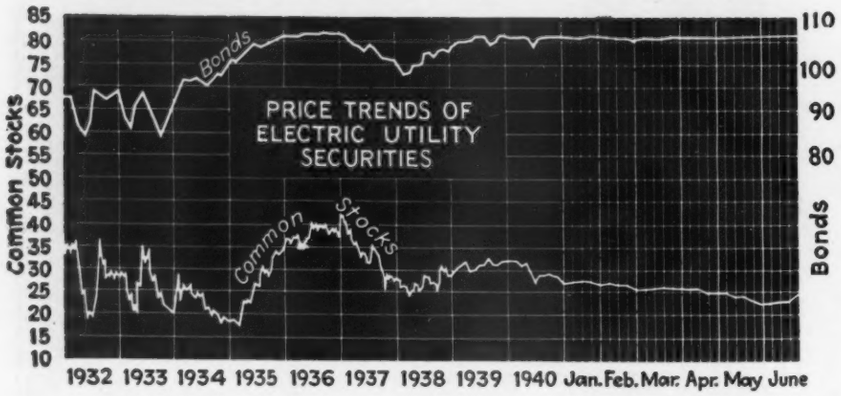
Revenue to ultimate customers totaled $228,158,900 in January, against $213,096,900 in the same 1940 month. February revenue was $217,628,900, against $203,265,100, and March revenues totaled $212,602,700, against $197,224,600 a year ago.

Average energy use per residential customer increased from 958 kw.-hr. for the year ended January 31 to 964 kw.-hr. for the year ended March 31, whereas in the 1940 period the increase was from 902 kw.-hr. to 913 kw.-hr.

E.E.I. report follows:

| | January | | | February | | | March | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1941 | 1940 | % | 1941 | 1940 | % | 1941 | 1940 | % |
| *Kilowatt Hour Sales—* | | | | | | | | | |
| Residential or domestic | 2,396,319,000 | 2,185,994,000 | + 9.6 | 2,194,845,000 | 2,037,156,000 | + 7.7 | 2,060,243,000 | 1,925,651,000 | + 7.0 |
| Rural (distinct rural rates) | 130,274,000 | 97,988,000 | +32.9 | 123,094,000 | 83,436,000 | +47.5 | 117,186,000 | 92,604,000 | +26.5 |
| Commercial or industrial | | | | | | | | | |
| Small light and power | 2,126,262,000 | 1,921,158,000 | +10.7 | 2,008,816,000 | 1,832,623,000 | + 9.6 | 1,924,313,000 | 1,768,582,000 | + 8.8 |
| Large light and power | 5,615,546,000 | 4,766,665,000 | +17.8 | 5,455,722,000 | 4,540,519,000 | +20.2 | 5,749,779,000 | 4,531,348,000 | +26.9 |
| Street and highway lighting | 214,554,000 | 207,634,000 | + 3.3 | 185,163,000 | 183,308,000 | + 1.0 | 179,481,000 | 173,560,000 | + 3.4 |
| Other public authorities | 254,110,000 | 235,051,000 | + 8.1 | 251,081,000 | 232,055,000 | + 8.2 | 247,982,000 | 225,868,000 | + 9.8 |
| Railways and railroads | | | | | | | | | |
| Street and interurban railways | 385,625,000 | 405,483,000 | − 4.9 | 350,011,000 | 358,602,000 | − 2.4 | 365,854,000 | 364,570,000 | + 0.4 |
| Electrified steam railroads | 194,390,000 | 179,623,000 | + 8.2 | 169,349,000 | 160,912,000 | + 5.2 | 186,708,000 | 172,612,000 | + 8.2 |
| Inter-departmental | 65,303,000 | 66,934,000 | − 2.4 | 63,318,000 | 66,417,000 | − 4.7 | 63,682,000 | 68,240,000 | − 6.7 |
| Total to ultimate customers | 11,382,383,000 | 10,066,530,000 | +13.1 | 10,801,399,000 | 9,495,028,000 | +13.8 | 10,895,228,000 | 9,323,035,000 | +16.9 |

## Utility Stocks Advance; Bonds Unchanged


Common Stocks
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
Bonds
110 100 90 80
PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
Bonds
Common Stocks
1932 1933 1934 1935 1936 1937 1938 1939 1940 Jan. Feb. Mar. Apr. May June

**Light and power stocks moved upward during the past week, "Electrical World" index advancing from 23.6 the preceding week to 23.9, the highest point since early May; last year, 28.7. Bond index remained unchanged at 105.7; last year, 104.9**

## Utility Files Plan to Exchange Stock

National Power & Light Co. has filed with the Securities and Exchange Commission a plan looking toward the liquidation of its outstanding $6 preferred stock by offering to holders of such stock its common stock holdings in the Houston Lighting & Power Co.

According to the plan, the holding company will offer holders of its 279,716 shares of $6 preferred stock the right to exchange their shares for the 500,000 outstanding no-par common shares of the Houston utility.

It was stated that if the program meets with the approval of the SEC the offer of exchange will be made either directly or through an arrangement with underwriting houses. Upon consummation of the program, according to the application, National's preferred stock dividend requirements of $1,678,296 annually will be eliminated or reduced to a comparatively nominal figure.

•

## Permit Debenture Issue

Stockholders of the Hartford Electric Light Co. have authorized issuance of $7,000,000 of 30-year debentures. The new debentures, to be dated September 1, will carry 3¼ percent coupons and are to be callable in 1956. Stockholders will be offered rights to subscribe for $1,000 of debentures for each 200 shares held and at multiples thereof.

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## Permits Gas Units Sale

Securities and Exchange Commission has authorized the Central States Power & Light Corp., a public utility company which also is a registered holding company in the Ogden Corp. holding company system, to sell its gas properties in Texas and certain relative assets, for $600,652. On its application to use the proceeds to acquire some of its outstanding first mortgage and first lien gold bonds by purchase in the open market at the lowest obtainable prices, the commission reserved jurisdiction.

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## Standard Invites Bids on San Diego Common

Leo T. Crowley, president of the Standard Gas & Electric Co., has announced that sealed bids would be received at the company's headquarters in Chicago on July 8 for the common stock of the San Diego Gas & Electric Co. held by the parent company.

Standard Gas & Electric owns 590,527 shares of common stock of San Diego and intends to divest itself of the controlling interest in this electric company. Previously, Standard Gas had offered to its debenture holders the common stock of San Diego Gas in an effort to reduce outstanding indebtedness. This exchange offer, however, has expired.

•

## Louisville Stockholders Deposit 85% of Stock

More than 85 percent of the 195,198 shares of outstanding 7 per cent and 6 per cent preferred stock of Louisville Gas & Electric Co. has been deposited for exchange for new 5 per cent cumulative preferred and cash under the offer which recently expired.

The new issue of 5 per cent preferred stock, amounting to 780,792 shares of $25 par value, was underwritten by a group of 41 underwriters. Due to the demands of existing stockholders, less than 15 per cent of the new issue was available for public offering and these shares have been sold.

•

## Utility Plans Large Preferred Issue

Reverting to former successful over-the-counter employee and customer ownership financing technique, Pacific Gas & Electric Co. plans to sell 400,000 shares of its $25 par 5 percent first preferred stock. There are 800,000 shares of such stock authorized but unissued, presently outstanding preferred being 5½ and 6 percent issues. The $10,000,000 to be realized from the sale will be used to reimburse the treasury for capital expenditures.

No announcement has been made as to offering price of the new issue but based upon present yields of the 5½ and 6 percent preferred an anticipated price of $26 to $27 per share is indicated. It is planned to sell 320,000 shares to the public and to reserve a certain amount to be sold to employees at a price not less than par. Last such offering by Pacific Gas was in 1932 when 200,000 shares of 6 percent preferred were sold to approximately 7,000 purchasers in six weeks. Preferred stock is now in the hands of about 59,000 stockholders of whom 48,000 are residents of California. Common shares are held by 67,000 stockholders of whom 21,000 are California residents.

•

## Will Clear Up Arrears

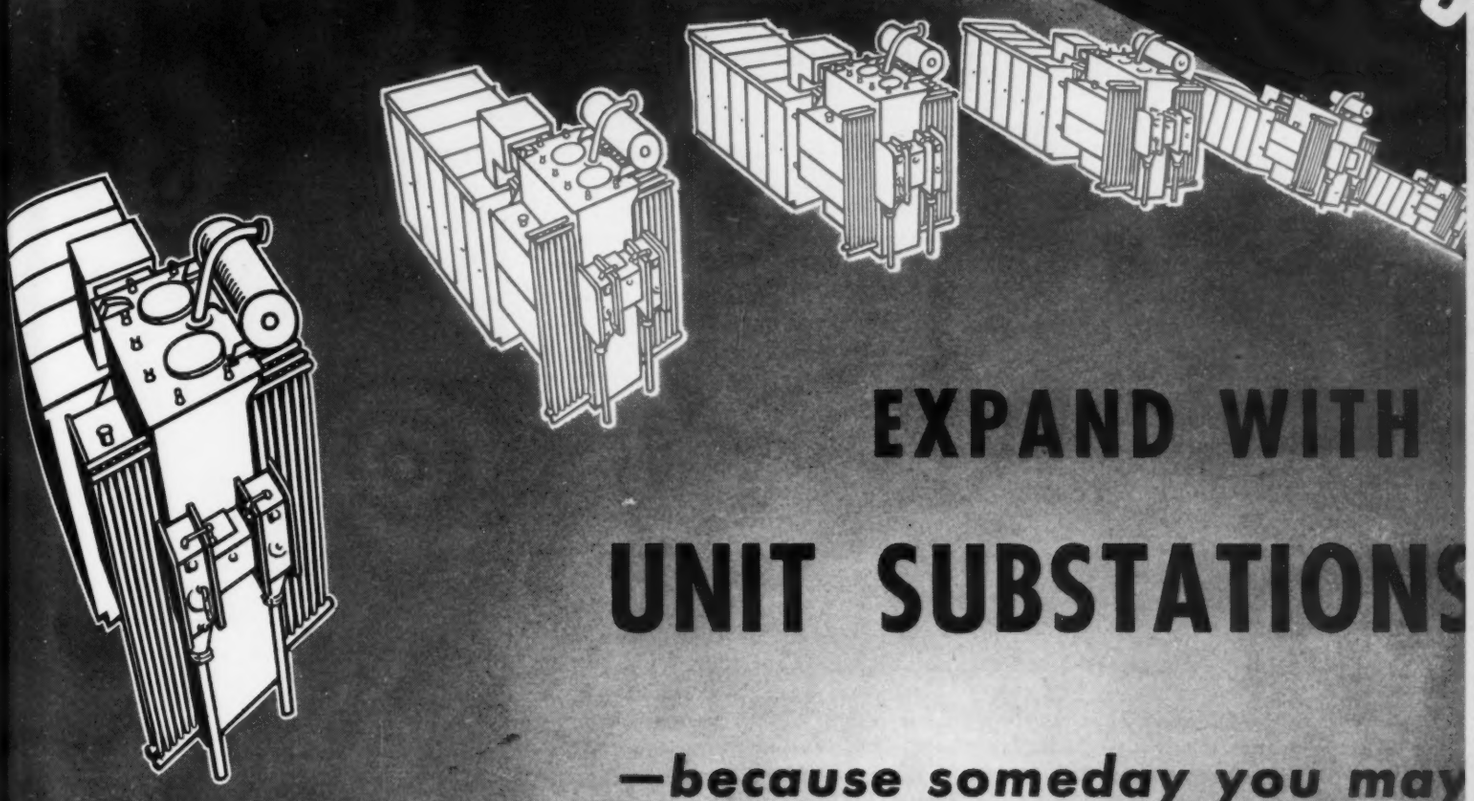
Florida Power & Light Co. is clearing up the arrears on its $7 and $6 preferred stocks with a payment on the former of $34.57 a share and on the latter of $29.63, both payable on July 1 to stock of record June 21.

## Utility Reports

| | Net Income 1941 | 1940 |
|---|---|---|
| *Arkansas Power & Light.. | $1,321,697 | $1,145,618 |
| *Birmingham Electric..... | 597,061 | 591,128 |
| *California Oregon Pwr.. | 1,028,242 | 916,906 |
| †Commonwealth & Southern and subs..... | 14,082,418 | 13,711,072 |
| †Detroit Edison and subs. | 11,365,295 | 10,208,097 |
| ‡Duquesne Light..... | 10,133,038 | 10,466,067 |
| *Idaho Power..... | 1,531,150 | 1,510,164 |
| *Kansas Gas & Electric... | 1,606,481 | 1,281,873 |
| *Louisiana Power & Lt.... | 1,047,332 | 1,085,376 |
| *Louisville Gas & Elec. (Ky.) and subs..... | 3,022,862 | 2,920,789 |
| *Mississippi Power & Lt... | 300,962 | 489,424 |
| *Oklahoma Gas & Electric | 2,632,921 | 2,755,676 |

*Twelve months ended April 30.
†Twelve months ended May 31.
‡Twelve months ended March 31.

# FARSIGHTED WAY TO SUPPLY TODAY'S LOADS



## EXPAND WITH UNIT SUBSTATIONS

***—because someday you may want to move them***

YOU'RE looking ahead when you install G-E unit substations. With them, you can add substation capacity, in small increments, *where* you want it *when* you want it. Equally important, you can move it to new, more effective locations when load conditions change. You will never have a large investment "frozen" in idle equipment.

You save secondary copper, reduce line losses, provide better voltage and better service, because you can install unit substations at the center of load areas. Installation is a matter of days, not weeks.

Add up all these advantages. We think you'll agree: for the changing power requirements of both today *and* tomorrow, G-E unit substations offer the practical, farsighted solution. Your local G-E representative can furnish you with complete information—or write for Catalog GEA-2996. General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

# OPERATING PRACTICES

## Compact Tie-in at Steam Plant

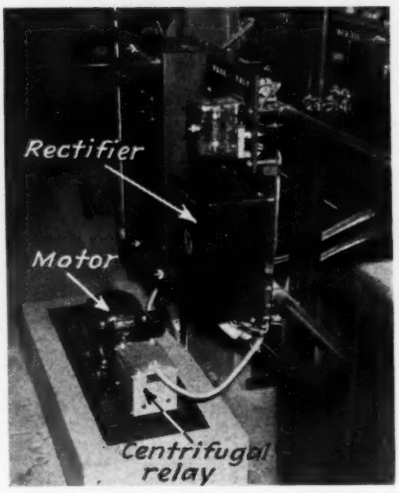
In an unused location between the steam plant of an Eastern utility and the company's general service building the end of a motor car driveway was effectively turned to account for erection of a 10,000-kva. transformer and switching installation tying the plant into a 22-kv. transmission circuit between distant load centers. The transformer was mounted over a concrete draining pit beside a river bordering the property, and in the triangular space left between the driveway and a flood protection wall at its end was built a high-tension bus structure with oil circuit breakers and disconnects systematically laid out as shown. The 22-kv. leads to the transformer were simply dead-ended on strain insulators fastened into the station wall, short vertical taps connecting with the transformer.

Wire fencing cuts off the substation from the driveway and safeguards it against backing up of trucks as well as keeping out unauthorized persons. An overhead cable feed into the station behind the transformer provides for a short connection to the buses inside. All equipment is mounted well above anticipated maximum river stages, and despite the odd shape of the plot and its constricted area a clear-cut layout was insured.

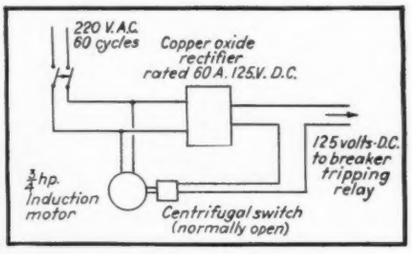
■

## Centrifugal Relay Protects Turbine

A unique centrifugal overspeed relay arrangement is being used at the Cheyenne, Wyo., plant of the Cheyenne Light, Fuel & Power Company to prevent overspeed operation of interconnected hydro turbine from forcing a dangerous increase in steam turbine speed at the Cheyenne plant.



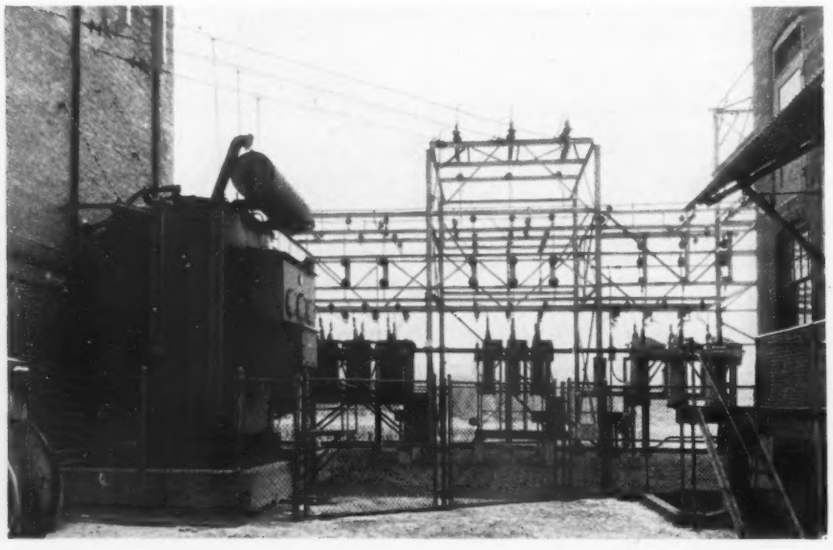

**CENTRIFUGAL RELAY** protects steam turbine from effects of hydro turbine overspeed operation


220 V.A.C.
60 cycles
Copper oxide rectifier rated 60 A. 125 V. D.C.
125 volts D.C. to breaker tripping relay
¾ hp. Induction motor
Centrifugal switch (normally open)

**SIMPLE** overspeed relay device

Elements of the relay scheme are shown diagrammatically in the accompanying illustration.

A lightly loaded ¾-hp. induction motor, which has a speed-frequency response almost identical with a more expensive synchronous motor, is used to drive a centrifugal switch. This switch is connected in the d.c. trip circuit of an oil circuit breaker in the interconnecting transmission line between the steam and hydro stations. Setting of the centrifugal switch is such that it will trip the breaker when turbine speed is 7½ percent above



**RIVERSIDE SPACE** between generating station and service building utilized for 10,000-kva. substation

**G.E. LEADS AGAIN by adding high-speed, low-energy operation to the many other advantages of these oil circuit breakers**

PNEUMATIC operation means substantial savings in the cost of control leads and batteries, since only a few amperes are required for the intermittent load of the small compressor motor, the trip coil, and the control valve. It is available on all G-E oil-blast breakers up to 230 kv.

An adequate supply of air for dependable operation is maintained by the compressor and specially designed pressure switches. The air storage system has sufficient capacity for any standard operating duty cycle.

Consider pneumatic operation for your next breaker. Our local representative can provide information to help you decide—or write for descriptive leaflet GEA-3616. General Electric, Schenectady, N. Y.

A right-side view of the weatherproof mechanism housing with the doors open to show (1) the pressure control, (2) trip coil for positive tripping, (3) compressor equipment, (4) control and safety valves, (5) the air storage tank.

**GENERAL ELECTRIC**

rating, although the turbine is reportedly capable of safe operation at 10 percent overspeed. After operation, the centrifugal switch resets automatically.

The induction motor is connected to the same 220-volt a.c. circuit as the 60-amp., 125-volt copper-oxide rectifier that supplies direct current for the breaker trip circuit. Thus, it is impossible for the motor to be operative without the rectifier, or vice versa.

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## All-Weather Truck for Street Light Cleaning

By C. TROUT
General Foreman Transmission Maintenance Dept., Cincinnati Gas & Electric Company

Cleaning of street light glassware was logically one of the first problems studied during an investigation of street light maintenance methods undertaken by this company some time ago. Since no available truck then on the market seemed to meet all the requirements, it was decided to design a truck for this purpose which would have an inclosed body to accommodate all materials, washing solutions and glassware necessary for a full day's work and which would also be equipped with a movable elevated platform for removal of boulevard globes and all types of suspension and pole-mounted lights.

Such a truck has been in service on the Cincinnati Gas & Electric system since December, 1939. Its design, details of which are shown, has the following features:

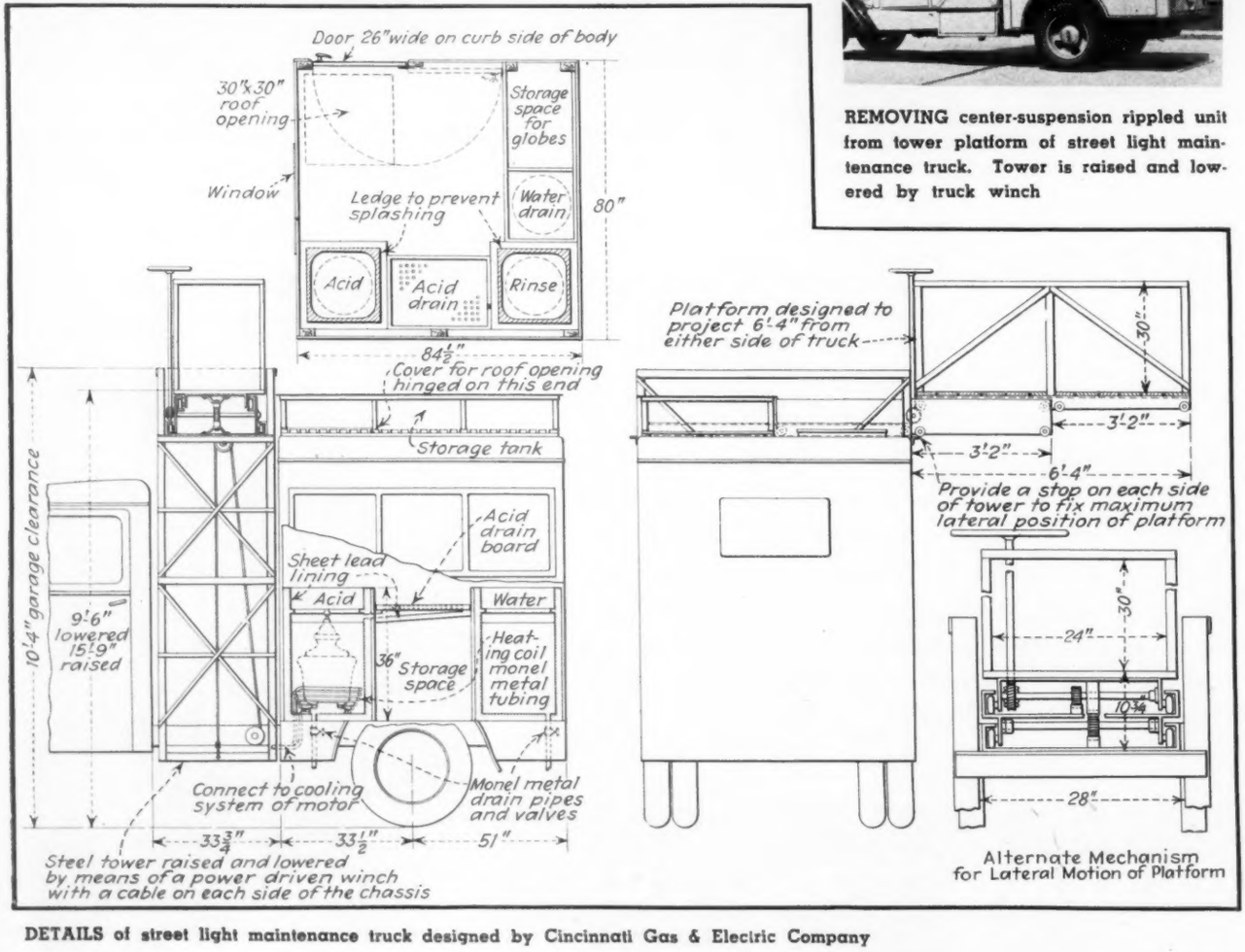
1. Complete body inclosure so that glassware may be cleaned in any weather.
2. Two large lead-lined tanks for cleaning and rinsing the largest boulevard globe by complete immersion. Tanks are lead-lined so that acid and other strong cleaning solutions can be used without damage.
3. Heat for cleaning solutions provided by a coil through which radiator water circulates.
4. Aerial platform capable of supporting three men and of reaching lamps from 8 to 23 ft. from ground. Platform is raised or lowered by power winch controlled from the driver's seat and is mounted on a gear rack to permit extending to either side over parked cars.
5. Minor features are a collapsible platform railing to permit storage in a low-ceiling garage. Signal button for communication between platform man and truck driver.

Three men are required to operate the truck. One man drives the truck and, upon signal, raises or lowers the platform. The platform man removes glassware, which he hands to the cleaner, who immediately returns to him a clean globe to replace it. If a lamp requires changing the platform man replaces it also.

The cleaner, wearing rubber gloves for protection against strong solutions, is inside the cab and washes all glassware. Removed globes are cleaned while the truck moves on to the next lamp.

Globes, removed as a unit, are im-

**REMOVING center-suspension rippled unit from tower platform of street light maintenance truck. Tower is raised and lowered by truck winch**

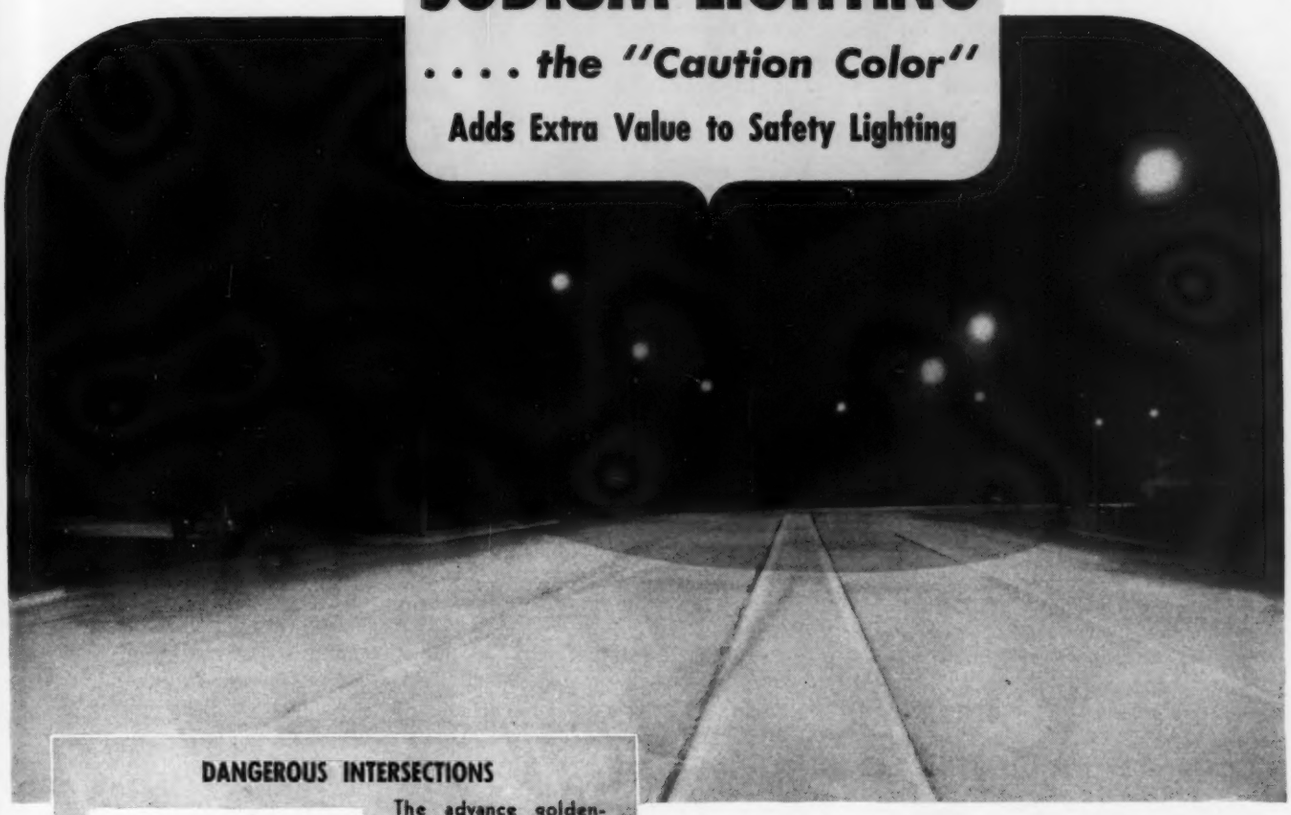



**DETAILS of street light maintenance truck designed by Cincinnati Gas & Electric Company**

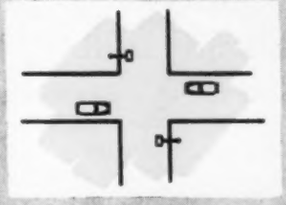
# SODIUM LIGHTING

## . . . . the "Caution Color"

### Adds Extra Value to Safety Lighting

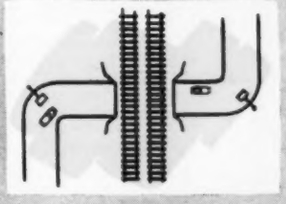


### DANGEROUS INTERSECTIONS



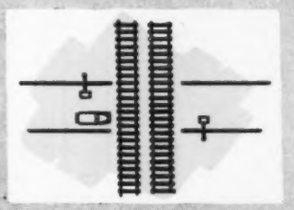
The advance golden-yellow warning and then the split-second indication of whether the intersection is occupied by a vehicle or pedestrian are desirable features that can be provided best with sodium illumination.

### RAILROAD UNDERPASSES



Low headroom, curving roadway, narrowing pavement make underpasses a source of serious danger for night traffic. First, by warning; then, by clearly revealing the situation, sodium lighting minimizes or eliminates the hazard.

### RAILROAD CROSSINGS



Sodium lighting, while not advocated as a substitute for grade-crossing elimination, is an inexpensive and practical method of preventing accidents. Two luminaires are usually sufficient for a two- or three-track crossing.

INTERSECTIONS with unfavorable accident experience deserve sodium lighting. The street or highway mileage represented is a small but very important part of the total and can be economically protected with a fixed lighting system. Sodium lighting serves a dual purpose in intersection lighting:

- The distinctive golden-yellow sodium color gives advance warning of a danger point.
- Sodium luminaires furnish an adequate level of well-distributed light at the intersection. Darkness —lack of adequate visibility—is eliminated; vehicles and pedestrians are easily seen.

The Novalux Type M-2 luminaire—a most efficient combination of parabolic and plane surfaces—is recommended for most intersections. If a more ornamental daytime appearance is wanted, the globe-type Form 81 luminaire is suggested. Why not light your dangerous intersections? It's often the "spark" needed to get public support for adequate lighting between intersections and on other thoroughfares. General Electric Co., Schenectady, New York.

GENERAL ELECTRIC

452-14-3010

mersed in a warm acid solution which dissolves and removes all dirt. After draining they are immersed in an alkaline solution to give lustre. This method is particularly effective on rippled glassware, which is left spotlessly clean. Glassware cleaned by this thorough method maintains a higher degree of brilliancy between cleaning periods.

In the best of weather, three men on the new truck average better than 60 per cent more globes than can be cleaned by three men working separately by the hand method of buckets and portable ladders. Since the truck is inclosed cleaning operations may proceed regardless of the weather.

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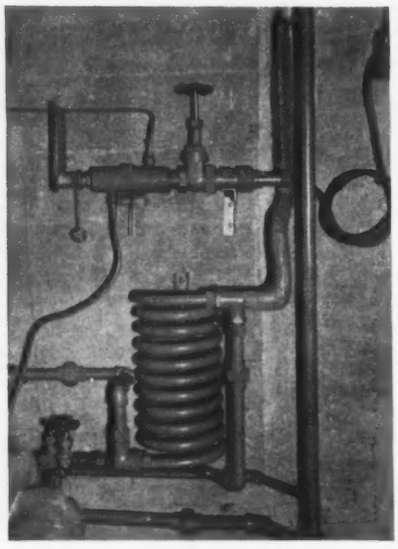
## Conductivity Control Reduces Carry-over



**SIX-POINT condensate conductivity recorder and typical measurement all used at a Southern steam-electric station to aid in the control of carry-over of solids in boiler water**

By virtue of the system of condensate and steam "conductivity" measurements used in a Southern utility power station to control the carry-over of solids that might lead to formation of deposits on turbine blading boiler blowdown is seldom necessary, as witnessed by the fact that make-up is consistently between $\frac{1}{2}$ and $\frac{3}{4}$ of 1 per cent at this plant.

The system boiler was originally designed for continuous blowdown. However, consideration of the substantial waste in steam, water and chemicals resulting from this practice led to the use of condensate for make-up and adoption of a system of conductivity measurements to guide boiler water treatment which has proved most effective, according to engineers of the company.

Conductivity measurements are made at the following points on the system: (1) condenser hot well, (2) evaporator condenser drain, (3) boiler superheater inlet, (4) transfer pump suction header and check coil. The conductivity, in ohms, is recorded on a six-point L & N recorder on the turbine control board on the turbine operating floor.

In general, conductivity as indicated by this recorder is kept above 50,000 ohms, with the exception of steam, which is maintained above 20,000 ohms. Sudden drops indicate the building up of solids in the condensate caused by leakage or changes in chemical treatment of the boiler water.

Conductivity measurements are made with a conventional conductivity cell used in conjunction with a Parker coil in which the condensate is cooled to a base temperature before measurements are made. The coil, shown, consists of two concentric pipes bent to form a coil. The condensate to be measured flows through the center pipe and around it cooling water that reduces its temperature to the desired level.

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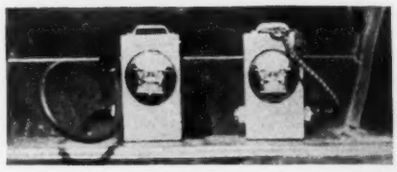
## Answers "High Bill" Complaints

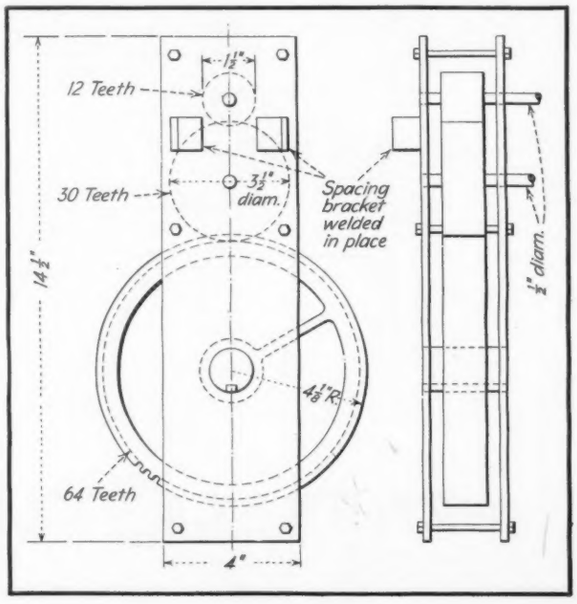


Two of the most valuable "trouble shooters" at the electrical department of the city of Dalton, Ga., are these regular indoor-type meters with extension cords and sockets so that they can be plugged in for either a range or any 110-volt appliance, according to Inspector Wendell H. Arthur. Whenever a complaint is received on a range or refrigerator one of these meters is plugged into the circuit to show the customer how to read the kilowatt-hours consumed.

## Lift Breaker Tank With Electric Drill

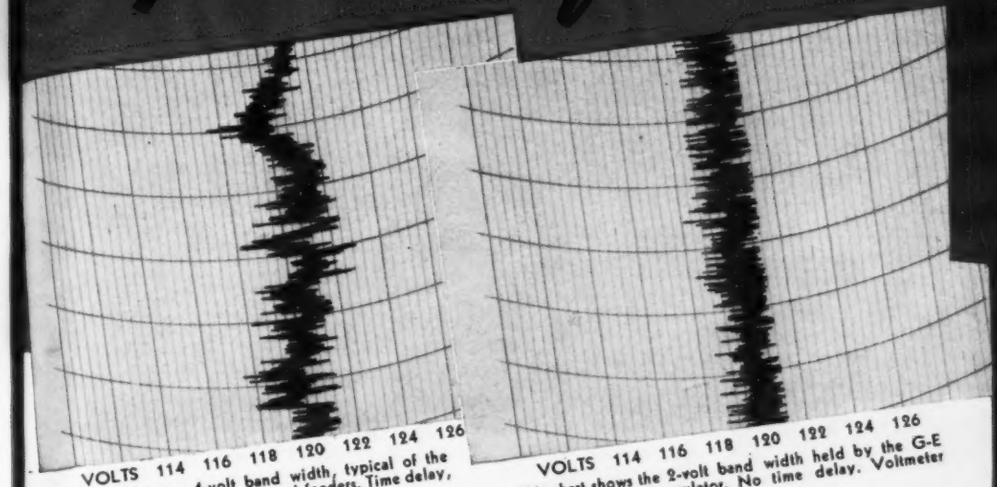
Substation maintenance crews of the Nebraska Power Company at Omaha are using a home-made gear box and electric drill to raise breaker tanks formerly raised with a hand crank. Tanks 3,000 lb. can be lifted in twelve minutes, which formerly took $\frac{3}{4}$ hour to raise by hand.

Details of the gear box are shown in the accompanying sketch. Three washing machine gears of $8\frac{1}{4}$, $3\frac{1}{2}$ and $1\frac{1}{2}$ in. diameter are used in the device. Shaft to which the hand crank was formerly attached engages the keyed hub of the larger gear. The chuck of the drill can be attached to the shafts of either of the two smaller gears extended. The middle gear ($3\frac{1}{2}$ in. diameter) is used for lowering and the smallest ($1\frac{1}{2}$ in. diameter) for raising the tank. Only reason for use of the middle gear was to provide the change of direction necessary for raising and lowering the tank with a drill running in one direction only. Speed of the drill motor is 475 r.p.m. at no load, 200 r.p.m. at full load.



# BAND WIDTH

## *The TRUE Measure of Regulator Performance*




This chart shows a 4-volt band width, typical of the voltage bands on many regulated feeders. Time delay, 25 seconds; voltmeter setting, 2 volts




This chart shows the 2-volt band width held by the G-E induction voltage regulator. No time delay. Voltmeter setting, 2 volts

BAND width tells you how close a regulating device is holding a predetermined voltage level. Band width is the range of voltage actually held on each phase of a feeder by the regulating device, rather than the setting of the voltage regulating relay.

Today the G-E induction regulator, with its immediate response and high-accuracy control, gives the term "band width" new significance. Band widths can no longer be considered "about the same." There's a difference—a real difference. And it can be evaluated in dollars and cents.

Recent tests show that the G-E induction regulator cuts the usual band width in half by holding feeder voltages within a two-volt limit or less instead of the four-volt effective band held by feeder voltage regulators of other types. The difference—two volts or more—can be utilized *with profit* in any one of several ways, depending on feeder conditions:

1. It can be used to increase load-carrying capacity—by as much as 67 per cent.
2. It can be used to extend feeder length—by as much as 30 per cent.
3. It can be used to decrease revenue losses due to excessive voltage drops —$1,000 annually on a typical feeder.

Find out how much the narrower band width held by G-E induction regulators can mean on your feeders. Ask your G-E representative to show you on simplified charts what you can gain in terms of feeder length, load capacity, or reduced revenue losses. General Electric, Schenectady, N. Y.

**GENERAL ELECTRIC**

604-16-5409

# INDUSTRIAL ENGINEERING

## Stroboscopic Method Checks Cloth Printing

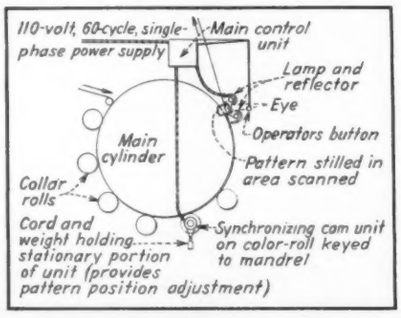
Stroboscope inspection equipment recently developed by General Electric for high-speed cloth printing machines permits accurate study of printed patterns at speeds above those possible under ordinary conditions and can be applied to most cloth printing machines without mechanical modification.

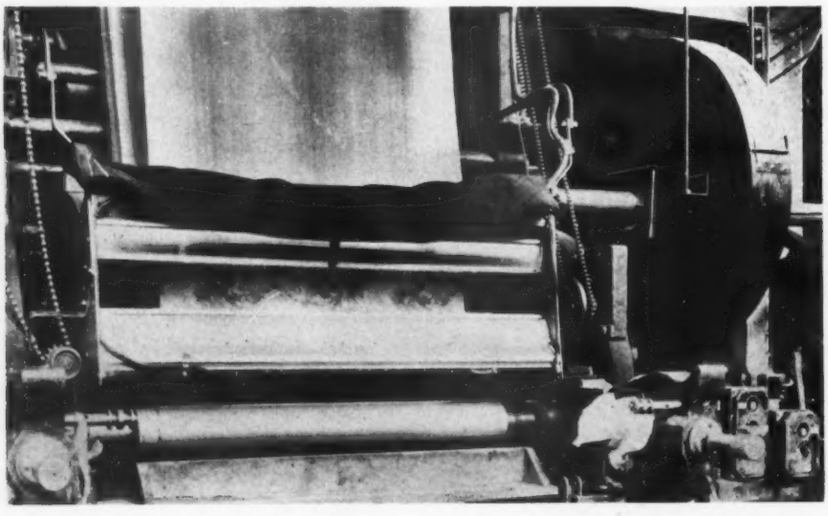
High-grade printing on cloth or paper requires that printing machine operators frequently check the location of each color on a finished pattern to note whether it is properly placed in relation to each of the other colors, or whether streaks or other imperfections have crept in during printing. Such conditions, if they exist, can thus be corrected with a minimum yardage of spoiled cloth.

Heretofore it has been difficult for even experienced operators to detect such imperfections in cloth traveling at speeds above 100 yd. per minute. By providing an intensive flash of light each time the pattern is in a certain position the new stroboscope system makes possible the accurate inspection of printed material at speeds up to 475 yd. per minute.

Repeated flashes of light, accurately synchronized with the motion of the cloth, make the pattern appear to stand still, thus enabling the printer to check color positions at high speeds without difficulty.

Three essential parts make up the stroboscope system:


110-volt, 60-cycle, single-phase power supply
Main control unit
Lamp and reflector
Eye
Operators button
Main cylinder
Pattern stilled in area scanned
Collar rolls
Cord and weight holding stationary portion of unit (provides pattern position adjustment)
Synchronizing cam unit on color-roll keyed to mandrel



**STROBOSCOPE equipment for high-speed cloth printing machines "stops" the pattern on this eight-color machine for inspection. Standard 40-watt fluorescent lamps are used in the reflectors. Diagram shows arrangement of parts**

1. The synchronizing cam mechanism, which acts somewhat like a distributor in an automobile, synchronizing the timing of the "flash" with the speed of the printing machine.
2. The main control unit (containing a transformer, condensers and thyratron and ignitron tubes), which provides the energy for the extremely short "flash" that makes accurate inspection possible.
3. Lamps, reflectors and brackets, providing the source of high-intensity illumination. Standard fluorescent lamps are used.

•

## Wall Mounting Saves Substation Material

In rearranging the electrical distribution system of the Whiting Milk Company, Charlestown, Mass., a 400,000-cir.mil, three-phase, 230-volt feeder was run from a new substation to a distributing point for lighting service where three 15-kva. transformers deliver 115-volt, three-wire energy to various adjacent buildings. In place of a pole-type transformer structure, the transformers were hung on a wooden frame lagged by $\frac{5}{8}$-in. bolts into the frame of one of the centrally located buildings and a simple bus structure provided above them as illustrated. The framing members are chiefly 4 x $5\frac{1}{2}$-in. verticals and 2 x 3-in. horizontal and bracket members. The incoming 220-volt feeder terminates at three horizontal conductors supported on pin-type insulators with an over-all bus length of about 7 ft. Below these taps are taken through fused cutouts and conduit to the primary bushings of the transformers, several secondary circuits being run as required overhead or in conduit to the lighting centers.

Each transformer serves one or more independent circuits, and it is estimated that at least one-third of the

HERE is a cable for use where bare wire won't do—where tree trimming would cost too much and where the right-of-way would be hard to obtain if other types were used. It can cut costs, as the 500,000 feet now in service have proved. Most of this footage is two-conductor; and experience with it has led our engineers to add two new classifications. These open up new places where this unique cable can lower the cost of installation and maintenance, improve regulation, better service, and add to safety.

### What SS Cable Is

The feature of SS cable is its outer covering. Steel wires, for mechanical strength to make the cable self-supporting, are interwound with copper conducting wires. The complete line now available includes two-, four-, and multiple-conductor.

### Where It Can Reduce Costs

Type SS cable is advantageous for use on urban, suburban, and rural power circuits in place of bare, weatherproof tree wire, or cable on messengers.

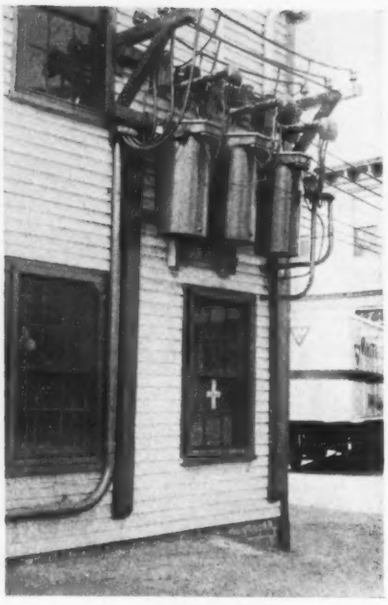
**The two-conductor type** is for single-phase circuits with one side grounded, from 4000 up to 15,000 volts.

**The four-conductor type** is for three-phase four-wire circuits with grounded neutral, up to 5000 volts. Each is insulated with No. 1799 varnished-cambric; the ground-return conductor is in the outer covering.

**The multiple-conductor type** is used for telephone, supervisory, and other control circuits. The most general size is No. 16 Awg stranded, ranging from four to ten conductors. The insulation is Thinwol rubber. The interwound armor on this cable is used only for suspension and mechanical protection.

Our new bulletin, GEA-2408A, gives more facts. For a copy address the nearest G-E office or General Electric, Schenectady, N. Y.

**GENERAL ELECTRIC**



**LIGHTING TRANSFORMERS on simple wood frame serve milk plant**

cost of an equivalent pole type structure was saved by this method of mounting. The distance of the transformers from the company's main substation was too great to supply 115-volt service economically from that point to the various lighting load centers. A 400-amp. disconnecting switch ahead of the transformer primaries controls the main lighting feeder.

•

## Capacitor Voltage Rise Burns Out Release Coil

By EUSTACE C. SOARES
Consulting Engineer, New York City

The no-voltage release coil on the main 240-volt secondary bus switch of a 1,500-kva. power transformer bank in an industrial plant burned out twice within a year. Search for the cause led to the discovery that on week-ends, when the plant load was all off, the voltage rise from a 360-kva. capacitor connected to the secondary bus for improvement of the power factor was high enough as in time to burn out the coil. Plant lighting was supplied through a separate 150-kva. transformer. The plant was not at first provided with a voltmeter, although later one was installed.

Tests made by the plant electrician indicated satisfactory voltage because such tests were always made under load conditions. Monthly half-hour demand readings for one year showed a range of 712.8 kw., 787.8 kva. to 784.8 kw., 815.9 kva., but for about 44 hours each week-end practically no power was used. Billing is based on power factor at time of maximum demand, so there was no advantage in having the capacitor connected to the bus over the week-end. Disconnecting the capacitor from the bus on week-ends thus prevented any further burn-outs of the no-voltage release coil without in any way interfering with efficient plant operation.

Although the capacitor was located within 100 ft. of the transformers and on the secondary bus, so that the reactance of the plant circuits did not contribute to it, the voltage rise was beyond the safe operating point for the no-voltage release coil.

•

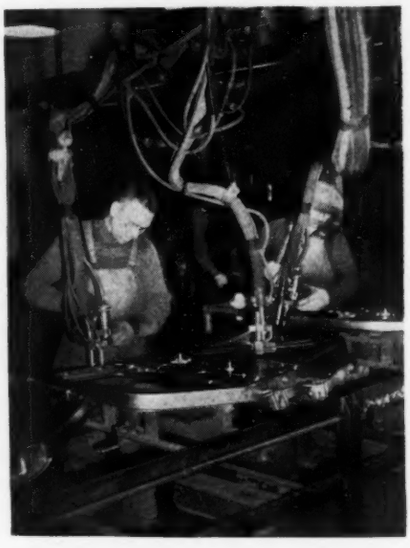
## Fewer Spots With Indirect Welding

By a unique modification of conventional spot welding Seaman Body Division of the Nash-Kelvinator Corporation, Milwaukee, Wis., obtains resistance welds which are characterized by having a discolored depression or "spot" on only one side of the finished weld. The technique used is called "indirect welding." It is used at the Seaman body plant in welding automobile door frames where presence of spot scars would mar the outside finish of the car doors.

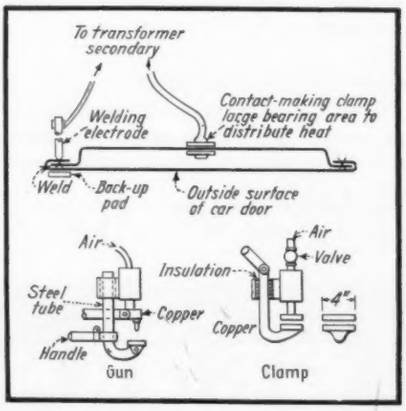
Instead of the conventional spot welding "gun" with two electrodes connected across the secondary of a welding transformer the indirect welding technique uses two separate "clamps," each connected to one leg of the transformer. One of the clamps is merely a contact-making device, the other is a welding clamp. The contact-making clamp may be thought of as a low-resistance copper "C" clamp with unusually large gripping surfaces. The welding clamp consists essentially of a single welding electrode and a non-current-carrying back-up pad of large area.

To make a weld with this equipment the contact-making clamp is attached to any structural element of the inside door frame, where it remains during the entire welding operation. The welding clamp, operated in the same manner as a conventional two-electrode "gun," is then applied to the points on the edge of the door frame where the welds are to be made, taking care to see that the back-up pad is on the side of the weld where no spot is to appear. Set up in this manner the welding current, for any instant, might be considered as flowing from one side of the transformer secondary through the contact-making clamp to the door structure, returning to the other side of the transformer through the electrode, completing the weld.

Welding transformer used with the indirect welding equipment is a conventional "75-kva." gun-welding unit operated at 440 volts primary. Secondary voltage of 16 volts is used instead of the 12 volts employed on conventional welding guns in this plant. Metal welded is 20 gage sheet steel. Weld duration is of the order of 2 to 2½ cycles and is automatically controlled.



**RESISTANCE WELDS with "spot" on one side only secured by unique indirect welding process at Milwaukee auto body factory. Contact-making clamp is at right, operator holds "gun"**




**SKETCH of car door section showing how indirect welds are made**

Shell Building, Houston, Texas. The 14 top floors were rewired with 100,000 feet of No. 12 Flamenol to provide increased illumination.

NEW LIFE FOR OLD BUILDINGS

Liberty Life Building, Columbia, S. C. This building was completely rewired with 110,000 feet of Flamenol using sizes No. 14, No. 12, No. 6 and No. 4.

# SPONSOR REWIRING WITH Flamenol* Building Wire

## Now Electrical Systems Can Be Modernized Inexpensively

The days when the cost of rewiring an existing building was extremely expensive are gone. Now wiring systems can be modernized inexpensively by replacing the existing wires in conduits with a larger number of Flamenol Small Diameter Building Wire or more Flamenol wires of the same size. New conduit installations with attendant repair cost are not necessary.

Everyone gains when buildings are brought up-to-date with Flamenol wire:

*Building owners* can rent more space
*Tenants* have wider use of electricity
*Factory managers* can increase efficiency
*Power companies* will have bigger loads

Flamenol Small Diameter Building Wire is available in sizes 14 to 4/0. It is insulated with a synthetic compound that is superaging, resistant to heat, oils, acids, alkalies and moisture. Same color range as Type R wires. Approved by the Underwriters.

For further information about Flamenol Building Wires or for samples, see the nearest G-E Merchandise Distributor or write to Section W-196, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

*Reg. U.S. Pat. Off.

**G-E WIROMETER**
For Computing Wiring Problems in Accordance with 1940 N. E. C.

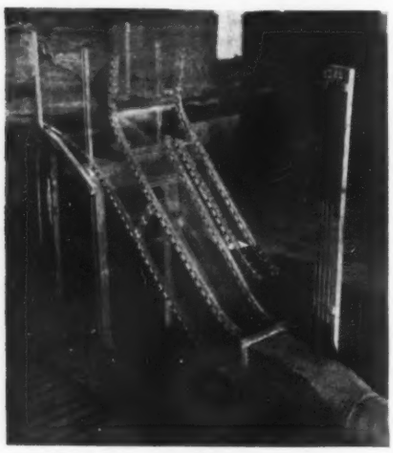
Power salesmen will find the Wirometer helpful in selecting the right wire quickly when making rough layouts. The Wirometer permits quick calculation of conduit fill, etc. Wirometers may be obtained from G-E Merchandise Distributors.

GENERAL ELECTRIC

# NEW ENGINEERING IDEAS

## Transparent Model for Intake Study Useful

To insure a thorough analysis of water flow through the penstock and spillway conduit of an Eastern hydro-electric plant, the hydraulic laboratory of the Worcester Polytechnic Institute recently tested a 1/24 scale model of "Lucite" which enables the behavior of the water to be observed at all points in its course prior to entering the waterwheel. This material, a DuPont plastic of highly transparent characteristics even up to thicknesses of 4 ft., is readily planed and drilled and is pliable at about 240 deg. F. It can be shaped as desired from sheets cemented or bolted together as required and is somewhat stronger than wood. When fractured it does not splinter, and a structure fitted with manometer tubes and gauges as shown throws much light upon water conditions, presence of eddies, wave formation and currents within structures concealed in the field from close observation. The use of dies further facilitates study of flowage.



**USE OF "Lucite" plastic material facilitates observation of flow conditions in intake of hydro-electric plant**

In the model shown the conduit entrance is 9x11 in. and in 30 in. the structure tapers to 5x5 in. The Lucite sheets are $\frac{1}{4}$ in. thick in this instance and are cemented together and further secured by $\frac{1}{8}$-in. bolts. Studies bearing upon the efficiency of the installation are aided by this method. Prof. C. M. Allen is director of the department of hydraulic engineering at W.P.I.

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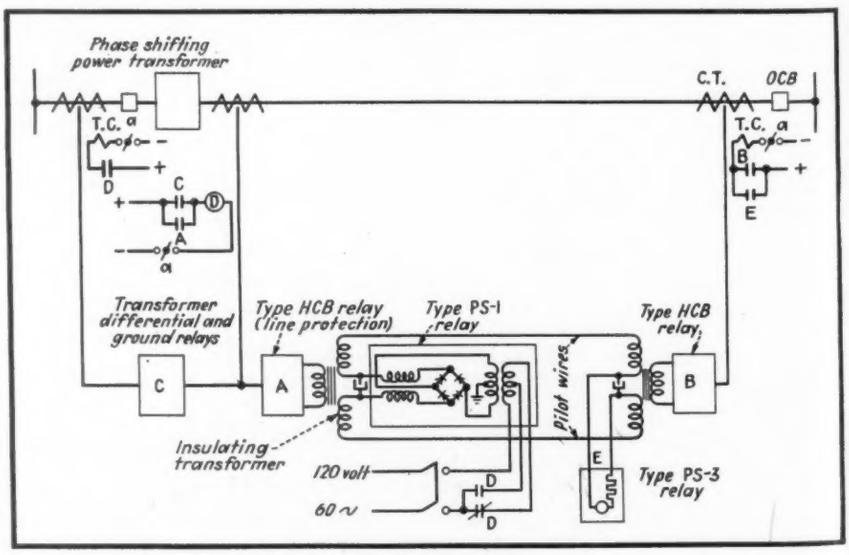
## Supvisory Circuit Performs Double Duty

By M. A. BOSTWICK

Relay Engineer, Westinghouse, Newark, N. J.

Oftentimes it is possible for a relaying scheme to accomplish more than the simple function for which it was designed or ordinarily used. A large Eastern utility made use of this double duty when it installed a large phase-shifting transformer at one end of a 10-mile, 26-kv. line. As shown in the diagram, no circuit breaker was installed between the line and the power-flow unit. A pilot-wire relaying scheme was planned to give protection for any fault occurring in the line section. Because of the shift in the phase angle of current (sometimes over 20 deg.) as it passed through the power-flow unit, it was considered best not to include the transformer in the pilot-wire circuit. Thus, it offered no protection for any internal fault in the transfer itself. Inasmuch as the phase shift unit had several windings, the current of an internal fault might be so low that it could not be detected by relays at the remote end of the line. Internal-fault detection was provided by differential relays and extremely sensitive ground relays located in the neutral circuit. These relays do, of course, open the breaker adjacent to the regulating transformer, but cannot control the distant breaker.

[*Continued on page 86*]




**PILOT WIRE supervisory circuit serves double duty**

The pilot-wire supervisory check system is a means of a few milliamperes direct-current being circulated over the pilot wires. Any appreciable increase or decrease in this current which is indicative of a short circuit or open circuit somewhere along the pilot wires causes a relay to close from or back contacts to an alarm system.

To make this pilot-wire check system serve the new purpose as well, it was simply necessary to add another tap to the transformer supplying the energy for the direct-current system, and to place an overcurrent relay at the remote end where the breaker is to be opened. When the differential relays detect a fault in the phase-shift transformer, they cause the tap to be changed on the check circuit transformer. This, in effect, raises the voltage in the check circuit, increases the direct-current flowing over the pilot wires and operates the overcurrent relay 10 miles away, to trip the circuit breaker at that point.

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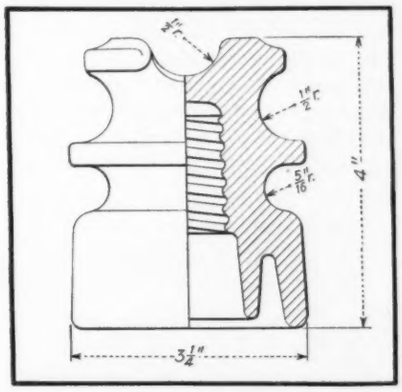
## Universal Pin-type Insulator Devised

Only one style of pin-type insulator for all distribution work needs now to be purchased and stocked by a large Eastern utility. A universal insulator recently devised obviates the former practice of buying side groove, top groove and double groove insulators (the latter used for breaking a series street-lighting circuit at a lamp cut-in).

The new design has the general appearance of standard insulators made by most of the insulator manufacturers. Principal difference is that the lower side groove, which merely provides increased leakage distance in standard insulators, has been increased in radius to take a wire; it has also been properly located to provide desired flashover values, as follows:

| | Flashover in Kv. | | |
|---|---|---|---|
| | Top Groove | Upper Side Groove | Lower Side Groove |
| Dry | 55 | 50 | 36 |
| Wet | 38 | 34 | 22 |

The radii of the top groove and upper side groove are such that they will take as a maximum a No. 4/0 tree wire, while the lower side groove will take as a maximum a No. 4 tree wire. The mechanical strength for the upper side groove is 2,000 lb. and for the lower groove is 5,000 lb. The insulators are available in either porcelain or lime glass.




**UNIVERSAL pin-type insulator takes up to No. 4/0 tree wire in top and upper side grooves and up to No. 4 tree wire in lower side groove**

•

## Performance Data for Cable Joints*

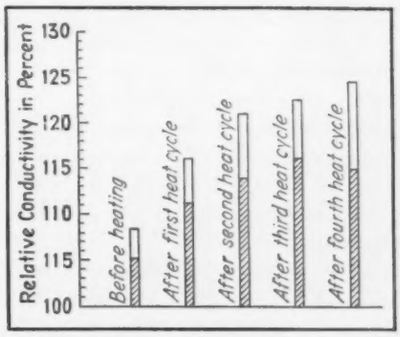
By MARVIN LEE
Chief Engineer, Burndy Engineering Co., Inc., New York, N. Y.

Operating experience with cable joints made with hydraulic presses has indicated that such joints are more efficient and less hazardous to make than soldered joints. In underground work it is unnecessary to provide a pull-out strength equivalent to the ultimate strength of the cable, and this type of portable tool has proved a rapid and convenient means of making the cable joints. Both hand- and foot-operated types of hydraulic presses are available. Either press accommodates a range of cable sizes from No. 6 through 500,000 cir.mil.

Performance data on joints made by this method are given in the accompanying table and graphs. It will be noted that the straight splice shows excellent conductivity even after repeated heating cycles—with the conductivity increasing for the first four or five cycles before leveling off to a steady value. Cable limiters, combining a connector and fuse for protecting secondary cables from overloads sufficiently great to damage the cable insulation, lend themselves to a pressed connection rather than to solder. At normal operating currents the fusible section of a limiter will not generate enough heat to damage its own insulation or that of the connected cable.

| Cable Size | Number of Indentations on Each Cable End | Pull-Out Tension in lb. | Relative Conductivity in Percent* |
|---|---|---|---|
| 1/0 Str. | 1 | 775 | 116.3 |
| 2/0 Str. | 1 | 980 | 108.5 |
| 3/0 Str. | 1 | 1415 | 112.1 |
| 4/0 Str. | 1 | 1438 | 111.7 |
| 250,000 CM | 1 | 2093 | 109.4 |
| 300,000 CM | 2 | 3538 | 127.9 |
| 350,000 CM | 2 | 3123 | 117.1 |
| 400,000 CM | 2 | 4457 | 118.9 |
| 500,000 CM | 2 | 5559 | 122.5 |

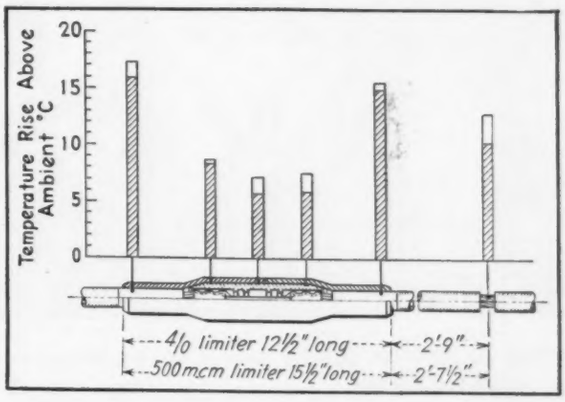
* Compared with equal length of cable.




**PERFORMANCE characteristics of cable joints made with hydraulic press**

Relative conductivity of such joints is shown by the table, which gives the average of a number of tests. The graph shows the effect of repeated heat cycles—heating a single joint to 200 deg. C. several hours and then cooling it to room temperature. Total height of columns represents relative conductivities of a 500,000 cir.mil joint; shaded height, conductivities of No. 4/0 joint.

* Republication rights reserved by Burndy Engineering Co., Inc.




**TEMPERATURE RISE on insulating jacket caused by passage of normal current through limiter**

Total height of columns represents temperature rise for 500,000-cir.mil limiter insulation; shaded height, rise for No. 4/0 limiter. Location of columns on diagram of limiter represents points at which temperature rises were measured. Normal current carried by 500,000-cir.-mil limiter, 400 amp.; by No. 4/0 limiter, 225 amp.

# LOAD BUILDING

## Utility Employs 85 Ft.-Candles, Fluorescent

Well-diffused and glareless lighting of a modern electric appliance shop has been provided by the Public Service Company of New Hampshire at its Keene divisional salesroom, where an average illumination of 85 ft.-candles is provided by 186 ft. of recessed fluorescent Wheeler flush trough equipment mounted in the ceiling.

Lighting units are double rows of 30-watt lamps end to end, made in 6-ft. sections containing two "Tu-lamp" ballasts per section, and without cross louvers. The rows are spaced 6 ft. on centers.

The ceiling height is 11 ft. 7¾ in. and the salesroom is 55 ft. 8 in. long x 21 ft. 9 in. wide. The unit area is 9.75 sq.ft. per 30-watt lamp. The walls are finished in flat white and the ceiling finish is of light acoustical material.

**KEENE SALESROOM of Public Service of New Hampshire now boasts 85 foot-candles of fluorescent lighting**

•

## Why We Purchase Our Electric Power

By JAMES R. ALLAN*
Assistant Manager
Industrial Engineering and Construction Department, International Harvester Company, Chicago

There are numerous angles that are recognized as factors contributing to the International Harvester Company's general policy of purchasing most of its electric power needs. Our policy in general has crystallized into the following points:

1. We are in the manufacturing business, producing coal, pig iron, steel, agricultural implements, farm and industrial tractors, stationary power plants, motor trucks, twine, refrigeration equipment and numerous collateral items. We are not in the business of making power. Efforts of our company must be directed to producing the above listed products.

2. We are gradually liquidating our power-generating equipment in favor of purchasing electric energy where there is not too great a cost differential.

3. We invest our new money in plant productive facilities and in improving our product, rather than in power plants on the basis of a long-time (five or six years) return.

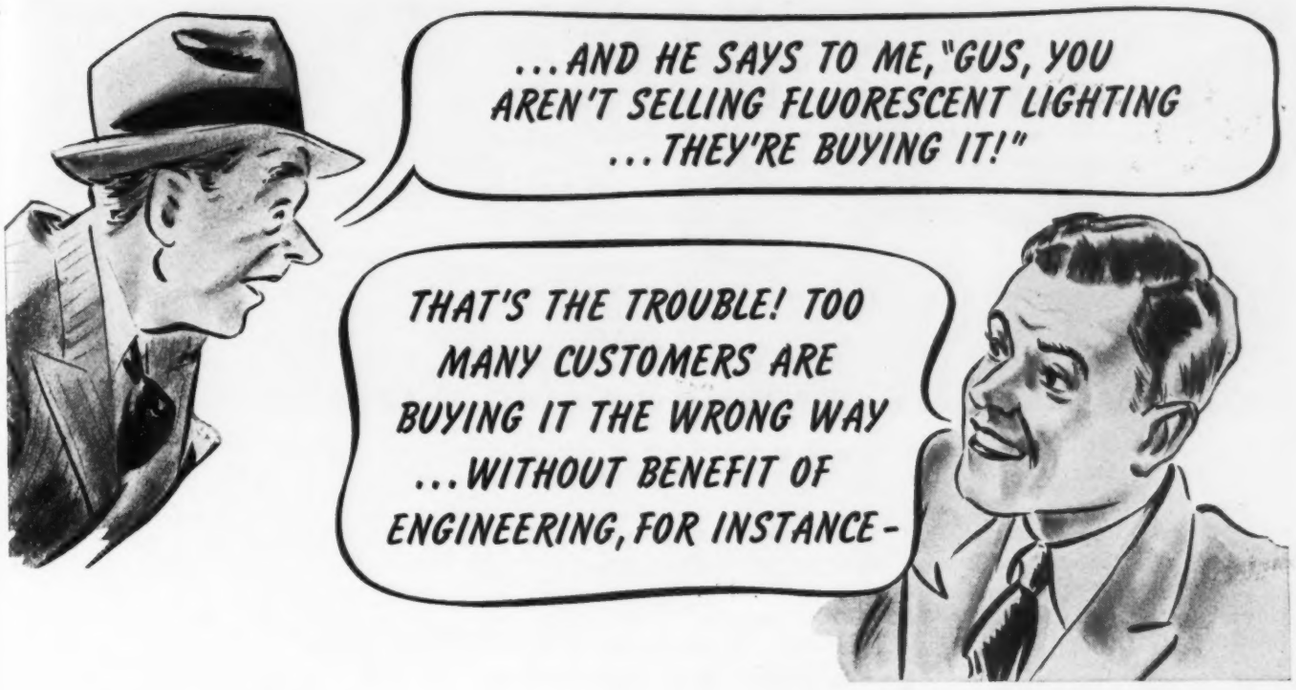
4. We recognize that utility companies present a large market for our product, particularly trucks and tractors. If we are large buyers of electrical energy and gas we think that it is reasonable to expect business consideration in return.

We have 26 properties in the form of plantations, mines, steel mills and manufacturing plants that produce raw materials or finished products in this country, Canada and Cuba. All these properties are supplied in total or in part by electric utilities for the requirements for power and light purposes.

In 1928 we operated twelve steam and hydro generating stations that produced 36,971,232 kw.-hr. We purchased 178,732,501 kw.-hr. In 1939 only five steam and hydro plants were left, producing 10,844,920 kw.-hr. We purchased 223,402,950 kw.-hr. Peak year for purchases was 1937 with 303,807,896 kw.-hr., as compared with the boom year of 1939 with 218,119,749 purchased. These figures definitely show our trend and adherence to the policy outlined above.

The average cost per kilowatt-hour went from $0.00982 in 1928 to $0.00826 in 1939, with the high of $0.01314 occurring during the last depression. The cost of power per man-hour worked, for more or less normal plant operations, varies from 1 cent to 7½ cents per man-hour

* Abstract of paper recently presented before Great Lakes Power Club, Palmer House, Chicago.


...AND HE SAYS TO ME, "GUS, YOU AREN'T SELLING FLUORESCENT LIGHTING ...THEY'RE BUYING IT!"
THAT'S THE TROUBLE! TOO MANY CUSTOMERS ARE BUYING IT THE WRONG WAY ...WITHOUT BENEFIT OF ENGINEERING, FOR INSTANCE -

GENERAL ELECTRIC recently made a survey of new fluorescent lighting installations in small stores. Here's what it showed:

*Installations as a result of direct sale*.....37%

*Installations as a matter of customer seeing a fluorescent job and inquiring where he could buy one like it* .....42%

*Installations as a result of one business man recommending fluorescent to another*.....21%

To be sure, a jobber, a contractor, or a manufacturer had been called in on all of these "sales." But, in more than two-thirds of them, the customer said, "I want fluorescent lighting. Where can I get it and how much does it cost?"

The contractor or representative made the quotation and furnished the fluorescent lamps and fixtures. He did not sell the job. It was bought.

Because too many of the average fluorescent installations are bought without adequate engineering help, too many jobs are poor. Many show poor fixture selection, poor light distribution, and don't provide enough light.

### WHAT TO DO ABOUT IT!

We both have a joint problem to see that good fluorescent lighting installations are made in the first place. More customers must be sold on the need for properly engineered lighting . . . the amount of light they need in order to produce maximum profits.

Utility lighting representatives are the only group large enough in number, who know the facts about lighting, and who can spend the time to tell the story of better lighting and its advantages to the average store and average industrial plant. This group is the hope of the lighting industry in helping contractors, fixture salesmen, and distributors' men, locally, to spread the gospel of the need for selling engineered lighting, and to tell the facts about increasing sales and producing fewer rejects, less spoilage, and better morale.

### G.E. HAS HELPS TO HELP YOU

To help utility men sell the higher lighting levels needed, General Electric now has available many new sales tools including:

**1** G-E Footcandle Selectometer—a device which the customer operates himself to determine how many footcandles he would like to have for proper seeing.

**2** A sales presentation easel and sales manual—with pictures, short copy, and sales ideas; to be used by the salesman talking either commercial or industrial lighting.

**3** The Seeing Spinner that demonstrates how good lighting speeds seeing.

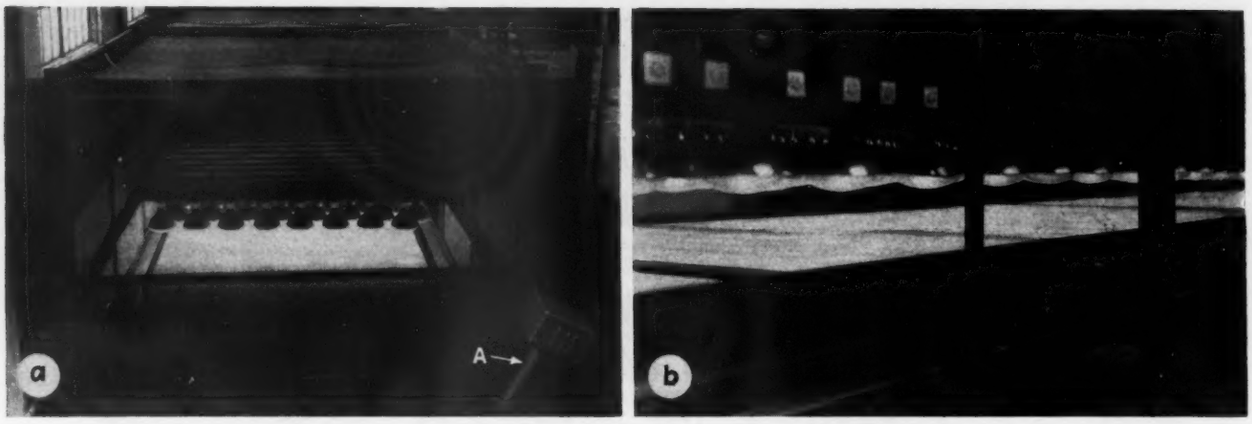
**4** A visibility meter or seeing selector which provides a means for demonstrating to the customer how good light makes seeing easier and quicker.

**IN ADDITION,** General Electric has slide films, booklets, direct mail pieces, and a manual of ideas—detailed suggestions for planning and carrying out a complete industrial and commercial lighting program. For complete information, see your General Electric lamp representative. General Electric Company, Nela Park, Cleveland, Ohio.

**G-E MAZDA LAMPS** *Made to stay brighter longer*

**GENERAL ELECTRIC**

HAVE YOU JOINED *the 49-er club?* SEE YOUR G-E LAMP REPRESENTATIVE!




**BANK of 456 R-40 infra-red lamps boosts drying speed from 19 to 36 ft. per minute over steam oven. New conveyor tunnel is one-third the length of old four-deck oven. Note photo-electric control at "A"**

worked, depending on the type of operation. During the depression period some eight years ago these figures ranged from about 4 cents to 51 cents per man-hour worked.

### *Desirable Rate Form*

As a large purchaser of power, and with our power requirements continually mounting, we have definite ideas of the contract best suited to industrial needs:

1. A low cost per kw. of maximum demand in varying brackets.
2. Demand determined on the average of at least three half-hour or one-hour peaks on at least three separate days of the month.
3. Monthly demand basis—each monthly demand independent of any previous month.
4. Power factor clause based on credit for power factor above, say, 85 per cent, and penalty for below 85 per cent.
5. Energy charges in varying brackets.
6. Discount for prompt payment.

In other words, a contract rate form very nearly approaching the block rate with power factor clause.

We like power factor types of contracts because we try to go the limit in maintaining good power factor in our operations. This means quite a battle with some of our shop men who prefer motorized equipment and do not understand the savings by group drives and our many other electrical problems.

Besides manufacturing plants, we have 338 separate locations with commercial contracts for power and light purposes. Last time the average cost per kilowatt-hour for these establishments was checked we found that in this country the rate averaged $0.0424 per kw.-hr., whereas in Canada it was $0.0372 per kw.-hr. Separately metered power in this country was $0.0725 per kw.-hr. and in Canada $0.107. Where light and power were consolidated under one meter, the U. S. average was $0.0548 and in Canada $0.0485.

Our company's policy in connection with our commercial branches is that we wish to be friends with the local utility company and that we are interested in their success, and in the same measure we hope that they will be interested in us.

•

## Infra-Red Bank Doubles Drying Speed

By A. J. DuPONT
Industrial Power Engineer
Interstate Power Company, Dubuque, Iowa

The photo-electrically controlled bank of 456 R-40 infra-red lamps that dries the finishing coat on fibre wall board at the Dubuque, Iowa, plant of the Maizewood Insulation Company has increased the speed of drying 90 percent over the steam drying methods formerly used. And, moreover, the new single-deck oven is one-third the length of the four-deck oven it displaced.

Prior to adopting infra-red drying methods, the coating that is applied to give the product a board finish was dried in a steam-heated tunnel 60 ft. long. This tunnel was equipped with four deck-conveyors that traveled 4¾ ft. per minute. Drying speed was 19 ft. per minute.

Increased demands for finished board led to concurrent demands for more floor space and greater drying speed than the steam-heated oven could provide without increasing oven length beyond permissible limits.

Experiments and calculations by the Maizewood company to determine drying time with infra-red methods indicated that the finish could be dried at the rate of 20 ft. per minute in a tunnel length of 20 ft.

The four deck-conveyors in the steam-heated tunnel were accordingly removed and replaced by one conveyor over which the infra-red lamp bank was installed. To do the drying in as short a space as possible, it was necessary to resort to high radiant energy concentration in watts per square inch on the material. To attain this end 250-watt R-40 G.E. reflector drying lamps were used. A total of 456 were installed, eight in a row on 6-in. centers with the bank 57 rows deep. Lamps in adjacent rows were staggered to give even heat distribution. Lamp sockets are mounted on metal wiring channel.

### *Automatic Control*

Power for the bank is supplied from 460-volt, three-phase service. Lamps are wired four in series. The bank is divided into two groups, each controlled by a magnetic switch. The pilot circuit of the switches is controlled by a photo-electric cell which automatically energizes the lamps when the board enters the tunnel and again turns them off when the board has passed the last bank of lamps. This function is only necessary when the paint sprayer is stopped for cleaning or refilling and at regular shutdown periods. The simple, automatic control relieves the operators from devoting attention to turning on and off the banks of lamps.

In addition to increasing the drying speed from 19 to 36 ft. per minute, the installation has saved handling costs of transferring the board from one deck of the four-deck oven to the next.

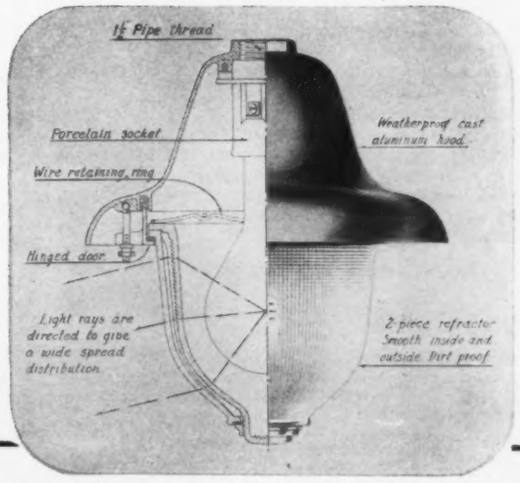
# NOW... HIT HARD at the SABOTEUR with PROTECTIVE LIGHTING

The "Might of Light" to decisively defeat danger, is recognized by all protective agencies and plant managements. The unique advantages of Holophane Refractors—particularly when used for fence lighting—make them especially effective in guarding against sabotage, espionage, and theft. These rugged miniature lighthouses, built for continued service under any type of adverse condition, are installed with a minimum of time and expense. Their economy is increased by these facts: no costly towers or complicated circuits required; no deterioration; trouble-free and dust-proof; use ordinary lamps. Holophane Refractors are stocked by your local distributor—available for your immediate call.

## HOLOPHANE REFRACTORS

### For Effective Fence Lighting and Low Cost Plant Protection

**You will find real value in the Holophane Book on Protective Lighting. Prepared for you by Holophane Engineers and available, without charge, upon request. Write for catalog PL.**


1½ Pipe thread
Porcelain socket
Wire retaining ring
Hinged door
Light rays are directed to give a wide spread distribution
Weatherproof cast aluminum hood
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Lighting Authorities—Since 1898
342 MADISON AVE.
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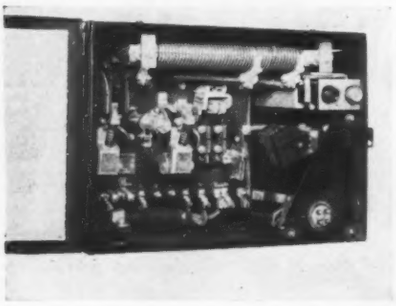
385 Yonge St., Toronto, Canada

# NEW EQUIPMENT

## Combination Starter

A d.c. combination starter for mining equipment, such as conveyors, pumps and fans, has safety features which include a



Combination starter with front-operated switch and built-in push button. **Westinghouse Elec. & Mfg. Co.**, East Pittsburgh, Pa.

line disconnecting switch, low-voltage protection, combination thermal, instantaneous overload protection, and safety interlocks to prevent opening the door unless the switch is in "off" position. Automatic starting and acceleration are accomplished from a built-in or remotely mounted push button.

•

## Multi-breaker

Industrial multi-breaker; capacities 15 to 100 amp., 230 volts, a.c. **Square D Company**, Detroit, Mich.

Both two- and three-pole forms of industrial multi-breaker have dust-resisting inclosure. All poles trip simultaneously. Thermal element affords a time lag on momentary overloads. A magnetic trip feature causes instantaneous tripping on heavy short circuits. A quick-make-and-break mechanism is also incorporated on the cover assembly. When breaker trips, white target signal appears in glass window in the nameplate.

•

## Welding Cable

Type "P-H" kickless welding cable, with almost any terminal for welding guns of any standard make. **Progressive Welder Co.**, Detroit, Mich.

New kickless cable of "full concentric" design has water supply core of $\frac{3}{8}$-in. interlocked bronze tubing. Six current-carrying bundles of seven copper strands each inclose the core; flexing causes them to "unwind" rather than bind, it is claimed. Reinforced rubber insulating tube separates these inner strands from outer strands. Between outer strands and external abrasion resistant cable covering there is space for water circulation.

•

## Motor

New design of explosion-proof motor announced by the company has construction for Class 1, Group D installations, where the surrounding atmosphere is charged with

Explosion-proof motor. **Century Electric Co.**, St. Louis, Mo.

explosive quantities of acetone, alcohols, gasoline, lacquer, naphtha, natural gas, petroleum or solvent vapor.

•

## High-Voltage Lamp

"Sealed-silver" high-voltage lamp; six sizes from 100 to 1,000 watts and in seven different high voltages from 220 up to 300 volts. **Wabash Appliance Corp.**, 335 Carroll St., Brooklyn, N. Y.

New lamp is made with its own built-in reflector unit in the form of a solid silver lining hermetically sealed inside the bulb. A nickel neck reflector disk is said to redirect the light that would ordinarily be wasted through the neck of the bulb.

**BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.**

## Thyrite By-Pass Holder

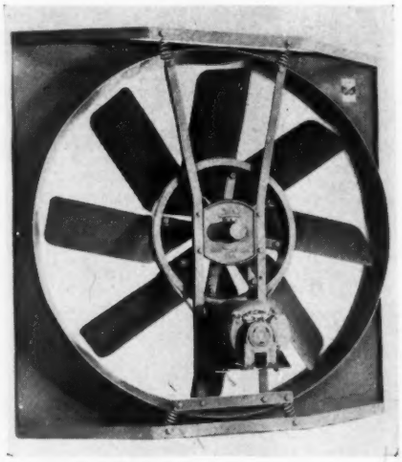
New thyrite by-pass holder has been announced for use with type SL transformer protective devices to prevent lighting circuit outages due to lightning surges. Clips are of stainless steel. Shell is made of black "Textolite." Four cover clips are provided. New holder can be used interchangeably with the standard film cutout holder in aerial-type protective devices.

Novalux thyrite by-pass holder. **General Electric Co.**, Schenectady, N. Y.

•

## Fans

Attic fans announced by the company are said to have all moving parts cradled in sound-absorbing springs, eliminating vibration noise. When equipped with reversible motor, fan will blow in or exhaust at will. Operation in any position is permitted by ball bearings in fan hub and



Type "O" home-cooling fan; seven sizes, capacities range from 6,200 to 30,000 cfm. **American Coolair Corp.**, Jacksonville, Fla.

# *His motto is* BE PREPARED

Many boys who had been Boy Scouts fought in the World War. Many former scouts are being drafted now in the present preparedness program. One of the cardinal principles of a Boy Scout is *"Be Prepared"*.

Hubbard and Company, too, has learned the value of this principle from years of experience in supplying the utilities of America with Pole Line Hardware. We know that emergencies sometimes call for deliveries far quicker than production will allow and that the only answer to an efficient nationwide service is a nationwide merchandising and distributing system.

The three Hubbard factories and 172 electrical dealers, stocking more than 6,000 tons of ready-to-serve Hubbard Hardware have little to do with starting a fire without matches. They do, however, serve a far more important role in keeping the nation's wires hot and the home fires burning. Our combined stocks form a huge cushion of safety.

Hubbard and Company and its nationwide system of distributors are prepared.

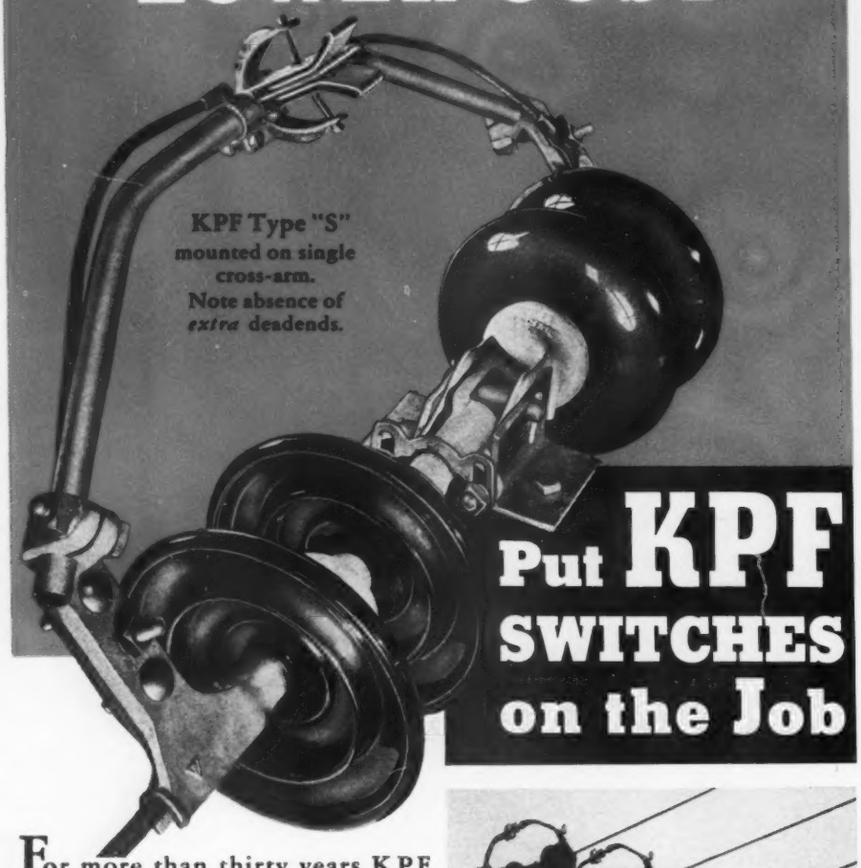
**HUBBARD AND COMPANY**

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO

**"HANG THE LOAD ON HUBBARD HARDWARE"**

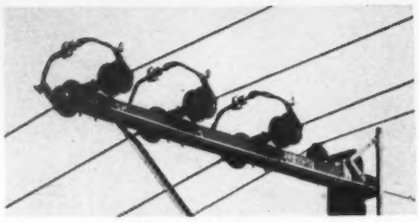
Greater dependability...more efficiency

LOWER COST



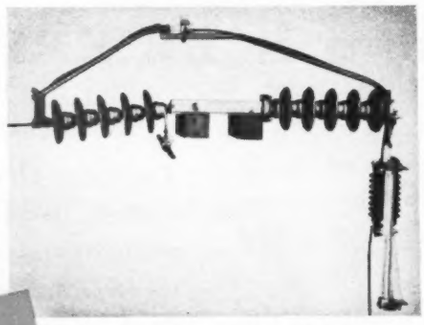

Put KPF SWITCHES on the Job

For more than thirty years KPF switches have been proving their inherent superiority in actual operation. Regardless of weather conditions or cross-arm warpage KPF switches always operate with ease.



KPF *Type* "S" *switch mounted on side arm. Note how conductor is brought directly to the switch insulator.*

Extreme simplicity of design and high quality of material insure this trouble free performance. The ease of installation—simply drill two holes in a single cross-arm and bolt on the switch—the elimination of extra deadends; conductor is connected direct to switch — the simple push-pull interphase control; unaffected by most severe cross-arm warpage — the full-floating, self-releasing contacts — (made of solid copper silver plated) give high conductivity free from corrosion.



KPF *Type* "UF" *switch which mounts on a double arm and provides a rigid stack with fuse holder for drop off. Ideal for substations.*

Get full details on the outstanding features of KPF switches. Write today!

FREE CATALOG

Let our engineers help you on special problems, without cost or obligation.

DO IT NOW!

KPF

Electric Company

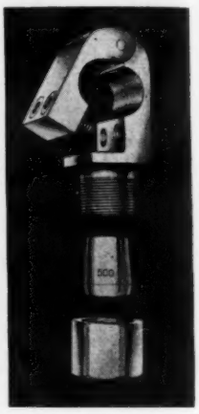
850 HOWARD STREET, SAN FRANCISCO, CALIFORNIA


when fan is equipped with ball-bearing motor. Blades are individually mounted and can be replaced in event of damage.

•

## Connector

Tee type of connector has hinged clamp which is attached to main conductor, by tightening screws. A two-bolt hinge is usually provided for cable branches No. 2 and larger; single-bolt for No. 3 and smaller. Split-cone contact unit assures a permanent grip on the branch. Contact surfaces for both the main and branch are serrated. Fitting may be reused with practically no deterioration, it is claimed.



Type "HFM" hinged tee connector: complete range of sizes for branch conductors. **Penn - Union Electric Corp.**, Erie, Pa.

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## Farm Freezer

"Zero-Temp—10 deg." farm freezer; capacities 8, 18 and 26 cu.ft. **Emil Steinhorst & Sons, Inc.**, Utica, N. Y.

New farm freezer unit has quick-freezing chamber and one or more zero storage compartments for food. Quick-freeze chamber has a portable forced-draft fan assembly for circulating air. Refrigerating machine is located in ventilated housing at end of unit. Adjustable temperature regulator is provided for quick-freezing operation and then is reset for storage temperature.

•

## Wiping Solder

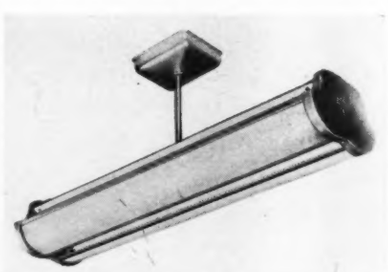
"Improved" wiping solder. **Joseph T. Ryerson & Son, Inc.**, 16th and Rockwell Sts., Chicago, Ill.

Solder for cable work, line splicing and other public utility applications has the original formula, 38 tin – 62 lead, to which has been added minute quantities of arsenic. The addition is said to be a grain-refining agent which improves workability and results in smoother non-porous, uniformly sound joints.

•

## Fluorescent Unit

New 150-watt commercial lighting unit with the combination of the company's



"Miralume C-150" lighting unit, uses 65-watt, 36-in. fluorescent lamps. **Hygrade Sylvania Corp.**, Salem, Mass.

# National Defense

## has PRIORITY

Just at present postponement of unnecessary construction may be a definite contribution to help our defense program along. If we can get along with what we have, or even part of what we have, the national economy will be that much better off for the moment at least.

When you install Simplex-LATOX cables you do not need any new conduit construction. We urge you to consider this angle if you need additional communication, control, signal or fire alarm cables. Simply take out your old cables and install LATOX cables. They have more than twice as many conductors as your old cable and yet are no larger.

The insulation in Simplex-LATOX cables is more than 90% pure, grainless, unmilled rubber compared with 30% rubber on cables made on ordinary specifications. LATOX insulated conductors are much smaller than conductors insulated with the ordinary wall of insulation and for that reason more of them can be put into a cable of the same size.

If you would like a copy of the catalog describing these new cables we will be very glad to send it to you.

**Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.**

# SIMPLEX WIRES CABLES

# LOOK Behind the Dial

## *Before Selecting Switchboard Instruments*

**Appearance is important, to be sure. That's why all Roller-Smith instruments are styled up-to-the-minute in attractive black cases . . . and equipped with legible, easy-to-read dials. But the vital parts of any instrument are behind the dial. The construction of the mechanism . . . the size of the magnet . . . the materials and careful workmanship —these are the factors that determine long-time accuracy and freedom from trouble.**

**Now, look behind the dial of a Roller-Smith Type RD. Notice the generously proportioned tungsten steel magnet . . . the permanent magnet moving coil mechanism . . . the sturdy bridge construction which assures permanent calibration.**

**Complete information and prices are contained in Catalog 48. Get your copy today from our nearest representative, or write Roller-Smith, Bethlehem, Penna.**

*Electrical Measuring and Protective Apparatus*

**ROLLER-SMITH COMPANY** BETHLEHEM, PENNA.

Switchboards • Metal Enclosed Switchgear • Electrical Instruments
Indoor and Outdoor Oil Circuit Breakers • Air Circuit Breakers

"Miracoal" reflector and frosted plastic panels provides diffused illumination. Unit is 36¼ in. long and is complete, ready to install.

•

## Fire Extingisher

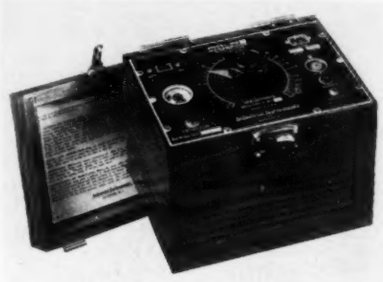
Model "No. 4" Kidde-Lux fire extinguisher. **Walter Kidde & Company, Inc.**, Bloomfield, N. J.

New 4-lb. carbon dioxide fire extinguisher is discharged by a pull on a trigger of a control valve. When trigger pressure is released the discharge is shut off. Nozzle arm is equipped with a swivel, so that the discharge horn is hold in a "down" position when the extinguisher is not in use. For operation the horn is swung into discharge position, aimed at the fire and the extinguisher discharged by a pull on the trigger.

•

## Megabridge

For checking of leakage resistance, in production test routine and in the field, the company has developed an instrument which uses the Wheatstone bridge principle. An



"Series MB" Megabridge. **Industrial Instruments, Inc.**, Jersey City, N. J.

electron ray null indicator replaces the galvanometer. Resistance measurement is read directly on the dial. Accuracy is said to be within 5 percent from 1 to 15 on the scale and as close as readable for the remainder of scale. Fluctuations of a.c. line on which instrument is operating have no effect on the accuracy of the readings, it is claimed.

•

## Magnetic Starters

Sizes "0" and "1" magnetic solenoid starters and contactors; for motors up to 7½ hp., single or polyphase, 110-550 volts, a.c. **Arrow-Hart & Hegeman Electric Co.**, Hartford, Conn.

New line of magnetic solenoid starters and contactors has separate Bakelite units for each pole. Separate inclosed electrical interlock switch is supplied normally open or closed. Reset button is independent of cover. Overload relays regularly supplied for manual reset, but can be changed for automatic reset if desired.

•

## Wet-Proof Casing

Wet-proof casing for electric heating pads. **DuPont Company**, Wilmington, Del.

Greater safety in the use of electric heating pads is promised by a new rubber-coated fabric for wet-proof casings. As the new casing material is vulcanized, the edges

# QUIZ

## What's your I.Q.* on the Electrical Wholesaler?

*Cover up the True and False columns below. Make up your mind on each statement. Check your knowledge!*

| | TRUE | FALSE |
|---|---|---|
| There is an appalling lack of public knowledge of the economic functions of the Electrical Wholesaler | ✓ | |
| He does not specialize in trade-marked, standard products that are best for public welfare | | ✓ |
| For the Electrical Buyer, he reduces hidden costs of distribution: Investment in stocks, storage, insurance, taxes, freight and cartage | ✓ | |
| He is unable to offer credit facilities, and has no immediate catalog and up-to-date price information | | ✓ |
| All electrical merchandise would be cheaper if it were sold direct from manufacturer to user | | ✓ |
| Today, more than 5000 of his Salesmen will distribute a couple of million dollars worth of load-building electrical merchandise | ✓ | |
| He provides manufacturers with intensive economical sales coverage, and reduces clerical and handling costs that otherwise would be passed on to the consumer | ✓ | |
| A manufacturer can be stopped from selling direct | | ✓ |
| A user can be stopped from buying direct | | ✓ |
| There is no law to compel a wholesaler to deal with manufacturers who compete directly with him | ✓ | |

**Most successful business men rate high in Intelligence Quotients.*

*Operating under The T & B Plan, this Electrical Manufacturer is doing everything in his power to strengthen and perpetuate what he believes to be the only economical system of distributing electrical products* — Through Wholesalers.

**THE THOMAS AND BETTS CO., INC.**

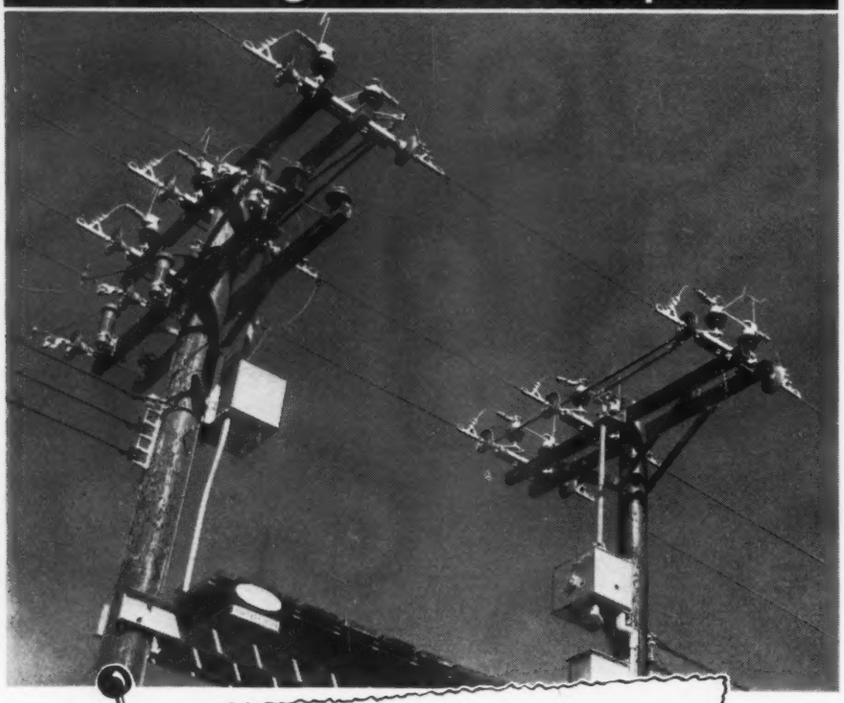
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

*T & B Distributors cover United States and Canada*

Factory, Engineering and Executive Offices, Elizabeth, N. J.

Sales and Service offices in 23 leading cities

# Southern States' MOTOMEKS Make Front Page News in Memphis:



"The line serving Municipal Airport went out . . . but an automatic throwover recently installed following a storm which threw the airport in darkness, switched on to an auxiliary line and service at the airport was uninterrupted."

Excerpt from front page of *Memphis Press-Scimitar*, May 9, 1941. On the previous night, a 39-mile-an-hour windstorm had swept across the city.

**THIS timely demonstration of the dependability of Southern States' MotoMeks is extremely important to you now that demands for uninterrupted power are being made every day by key industries, army camps, and other defense projects.**

***You can guarantee* your customers uninterrupted power when you install Southern States' MotoMeks which automatically switch important loads from a preferred to an emergency circuit when trouble strikes. Then, when voltage is restored on the preferred feeder, the MotoMeks return the load to this source without even momentary interruption.**

**Your Southern States' representative will be glad to talk with you further, or if you prefer, write Southern States' engineering department for information concerning MotoMeks now.**

Features of *MotoMeks*

STEEL - HOUSING is rainproof; padlocked to prevent tampering.

VERTICAL SHAFT is in direct line with the vertical switch-operating pipe. A coupling is all that is necessary to join the shaft to the operating pipe. *Oilite* bearings insure smooth operation.

LIMIT & AUXILIARY SWITCH can be adjusted in the field for either "a" or "b" operation.

POSITION INDICATOR & REVOLUTION COUNTER are plainly visible.

UNNECESSARY SWITCHING OPERATIONS are eliminated by the incorporation of Southern States' K-53 Time-delay Relay in all transfer schemes.

SIMPLE to install; MODERATE in cost.

INVESTIGATE Southern States' MotoMeks today. Your card or letter will receive prompt attention.

**Southern States Equipment Corp.**

Birmingham, Ala., Representatives In Principal Cities

★ ★ Already "Drafted" for Service on Several Major Defense Projects ★ ★


of the pad's covering can be sealed with cement instead of sewn. It is claimed that the danger of short circuits from moisture penetration is eliminated. Careful cementing of the card to the bag is an added protection.

•

## TECHNICAL LITERATURE

EYENUTS AND EYELETS — Specification covers the respective devices commonly used in overhead line construction. Material, dimensions, strength, preferred sizes, finish, inspection and rejection are some of the subjects contained in "Suggestions for Specifications for Eyenuts and Eyelets," publication TD-5-1941. Copy may be obtained from Edison Electric Institute, 420 Lexington Ave., New York, N. Y.

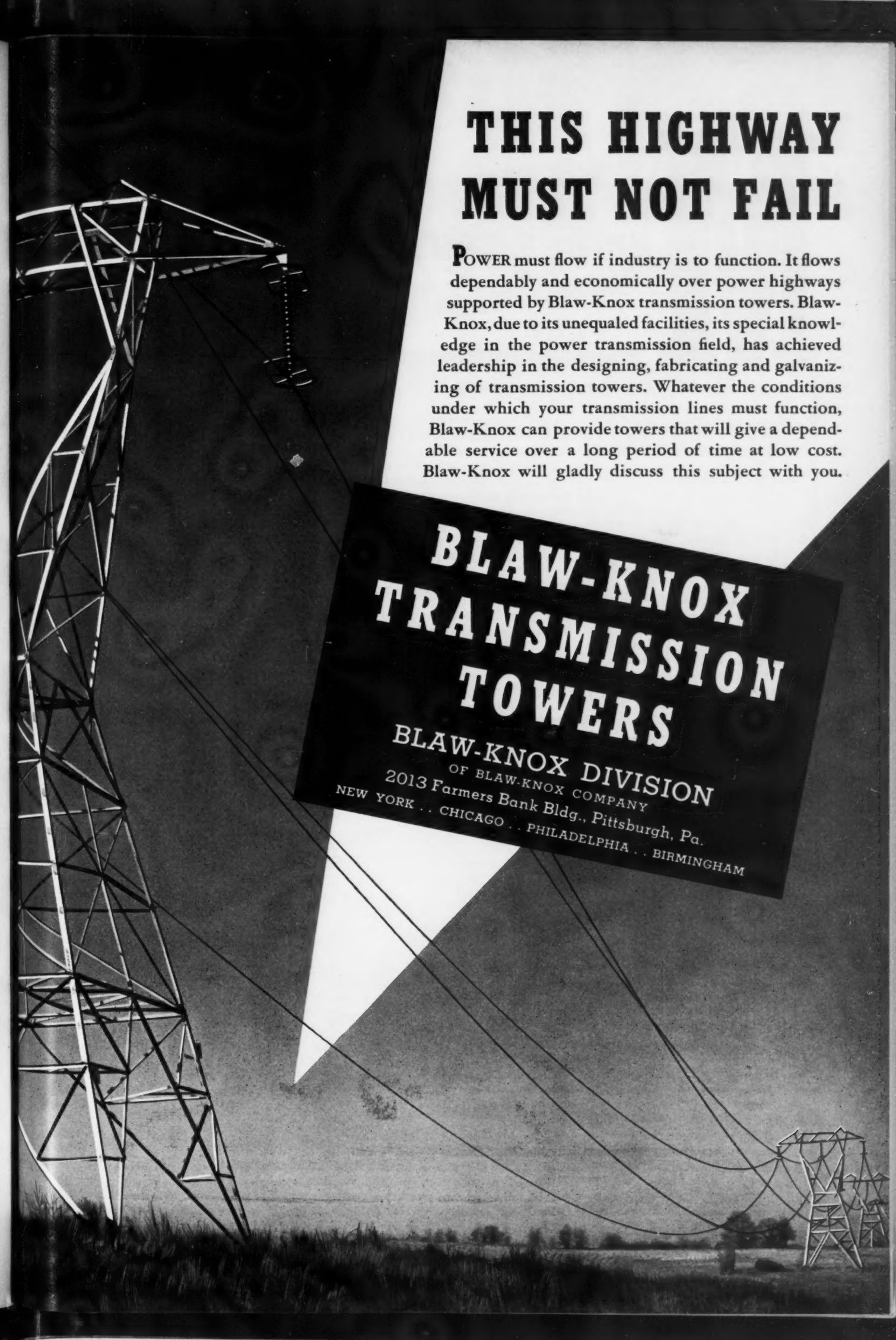
PAINT—A book, "Facts about White Paint and Better Illumination," contains charts showing the effect of paint on lighting and illumination, coverage of various types of paint, loss in reflection value with time, and special spectro-photometric comparisons of various colors and types of plant maintenance finishes. Also included is a graphic specification guide which shows maintenance engineers how to prepare each surface for painting and what type of paint to use. A copy of the 26-page book will be sent by Sherwin-Williams Co., Cleveland, Ohio, to any plant executive requesting it on his letterhead.

COPPER AND COPPER ALLOYS—Chemical and physical properties of 46 Revere Alloys, of free-cutting rods of leaded and leaded naval brasses, of various extrudable alloys, properties, weights and dimensions of copper water tube and brass and copper pipe, shapes of welded steel tube, and characteristics of welding rod, are some of the various data contained in a 44-page booklet, "Revere Copper and Copper Alloys for the Mechanical Industries." Copy may be obtained from Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

ABBREVIATIONS — Shortened forms of names or expressions employed in texts and tabulations and fundamental rules for their use have been approved as American Standard and are listed in publication Z10.1-1941, "Abbreviations for Scientific and Engineering Terms," available from American Standards Association, 29 West 39th St., New York, N. Y. Price 35 cents.

MEASUREMENT CONVERSIONS—Millimeter to inch conversions from 1 mm. to 300 mm. and a comparison of metric-English measures of weight and length are listed on an 8½x11-in. card, "Technical Data Card No. 112," which may be obtained from the Babcock & Wilcox Tube Co., Beaver Falls, Pa. Kindly make your request on company letterheads or give your company connection.

BELTING—A 12-page publication "Selection and Maintenance of Rubber Transmission Belts," Catalogue Section 2150, is a guide to application and care of flat rubber belting, covering type, grade, width, thickness, length, horsepower capacity, corrections of horsepower rating, importance of bearing capacity in applying rubber belts, belt joints, and endless belts. The pamphlet also presents results of experience in maintenance on such points as belt dressing, cleaning, storing, static, oil, salvage, and suggestions for maintaining belt records. Copy may be obtained from the B. F. Goodrich Company, Akron, Ohio.


THIS HIGHWAY MUST NOT FAIL
POWER must flow if industry is to function. It flows dependably and economically over power highways supported by Blaw-Knox transmission towers. Blaw-Knox, due to its unequaled facilities, its special knowledge in the power transmission field, has achieved leadership in the designing, fabricating and galvanizing of transmission towers. Whatever the conditions under which your transmission lines must function, Blaw-Knox can provide towers that will give a dependable service over a long period of time at low cost. Blaw-Knox will gladly discuss this subject with you.
BLAW-KNOX TRANSMISSION TOWERS
BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2013 Farmers Bank Bldg., Pittsburgh, Pa.
NEW YORK . . CHICAGO . . PHILADELPHIA . . BIRMINGHAM

# MANUFACTURING - MARKETS

## Expansion Planned by American Steel

Plans for rehabilitation, consolidation and expansion of its facilities for the manufacture of rods, wire and wire products in the company's plants at Joliet and Waukegan, Ill., were announced last week by C. F. Hood, president of American Steel & Wire Co., Cleveland, Ohio.

The program includes the construction of a new coarse rod mill and a new mill for the manufacture of merchant products at the Collins Street plant in Joliet, which, upon completion, will replace the present facilities at the Rockdale and Scott Street plants in the same city.

At Waukegan replacements, rearrangements and improvements will be made to increase the efficiency of the mill. The Waukegan program includes provision for adequate rod storage, replacement and relocation of rod patenting equipment, replacement of heat-treating equipment, replacement and relocation of straightening and cutting and timing equipment, improvements and replacements in the spring mill to afford better arrangement and versatility in manufacture, replacement of cleaning house and of iron sulphate facilities, extension to warehouse space, and an addition to the present office building.

•

## Manufacturers Advised on Government Contracts

The Department of Commerce, Service and Information Office, has advised manufacturers not to employ "lobbyists" in the effort to obtain government contracts. It was stated that the Service and Information Office is equipped to inform manufacturers whom they should contact and exactly how to do so.

Manufacturers were urged not to go to Washington, at least until they have carried on preliminary negotiations by mail with the purchasing agency that handles their particular products. When it is necessary to go to Washington, it was said, the Service and Information Office will gladly arrange for the business man to see the particular official with whom contact should be made.

•

## Dubilier Condenser Sale

Stockholders of Dubilier Condenser Corp., at a special meeting, approved the transfer and sale of all of the rights, title and interest of the company in patents and patent rights to Cornell-Dubilier Electric Corp. for $7,500. Upon ultimate dissolution of Dubilier Condenser, its stockholders will receive one share of Cornell-Dubilier stock for each three shares now held. Miss A. Starr has been elected secretary and treasurer, succeeding M. D. Joyce.

## Range Sales in May Advance Over 1940

Sales of electric ranges in continental United States, Alaska and Hawaii during the month of May amounted to 65,359 units, according to a bulletin released by the National Electrical Manufacturers Association. Eighteen companies participated. This compares with 42,983 units in May, 1940, with 19 companies participating.

For the first five months of 1941 the number of units totaled 295,004 (18 companies), compared with 195,327 for the similar period of 1940 (18-19 companies).

•

## Oil Burner Orders

New orders received in April for oil burners by 159 manufacturers totaled 23,642, against 22,013 in March and 15,889 in April, 1940, according to the

**MORE LIGHT—Day-Brite Lighting, Inc., St. Louis, completely equipped its general and private offices with fluorescent fixtures, using open-type Troffer units for one 48-in., 40-watt lamp each installed in an ocoustical ceiling on 4x6-ft. centers in the general offices and continuous Troffer with glass panels in private offices**

# NOW *Fully Electro-Magnetic* CIRCUIT PROTECTION

with

# HEINEMANN

## "MAGNETTE" SERVICE CENTERS

Here's a new, positive acting protective device for branch circuits, easily installed in any desired location. It is adaptable for all types of residential and apartment house wiring and the enclosure, for either flush or surface mounting, is attractively designed with a gray crackle finish over a rust resistant coating which protects the metal box.

- Trips instantaneously on short circuits.
- Delayed trip permits harmless overloads of short duration such as passage of inrush current.
- Carries 100% of rated current without opening, regardless of number of breakers in unit.
- It is not affected by changes in temperature.
- It can't be held closed against existing overloads or short circuits.
- Breakers are equipped with magnetic blowout which quickly quenches the arc.
- Listed as standard by Underwriters' Laboratories and complete service center bears Underwriters' Service Equipment Label.

## HEINEMANN ELECTRIC CO.

**103 PLUM STREET** *Established 1888* **TRENTON, N. J.**

Department of Commerce. Unfilled orders at the end of April totaled 15,266, against 14,443 in March and 4,375 a year ago. Shipments totaled 22,819 in April, 17,891 in March and 14,394 in April, 1940. Stocks at the end of April totaled 23,701.

•

## Enlarge Mansfield Plant

An expenditure of approximately $1,500,000 will be made by Westinghouse Electric & Manufacturing Co. for enlargement of its Mansfield, Ohio, plant. The expansion includes an addition to the present vitreous enameling building and a new enameling furnace to supplement the three furnaces now in operation.

•

## Expands Turbine Plant

General Electric Co. has approved plans for a new branch plant at Bellevue, Ohio. The company has begun construction of a new one-story addition at its main works, Schenectady, N. Y., for expansion in the turbine production division.

•

## Kitchen Laboratories

Hotpoint has completed its new kitchen laboratories at Chicago and will begin July 7 a series of eight five-day sessions in courses designed to cover all phases of home economics in major electric appliance selling, demonstrations and user instruction. Sessions will continue through August 29.

•

## Graybar Reports Net

Graybar Electric Co., Inc., reports for 1940 net income of $1,096,332, compared with $1,503,785 in 1939.

•

## Seeks SEC Exemption

Westinghouse Electric International Co. has filed an application with the Securities and Exchange Commission for exemption from the provisions of the Holding Company Act.

### New York Metal Prices

| | June 24, '41 Cents per Pound | June 18, '41 Cents per Pound |
|---|---|---|
| Copper electrolytic | 12.00* | 12.00* |
| Lead, A. S. & R. Price | 5.85 | 5.85 |
| Antimony | 14.00 | 14.00 |
| Nickel, Ingot | 35.00 | 35.00 |
| Zinc Spots | 7.64 | 7.64 |
| Tin, Straits | 53.00 | 52.375 |
| Aluminum, 99 per cent | 17.00 | 17.00 |

* Delivery Connecticut Valley.

# Field Reports on Business

*Purchases of heavy electrical equipment continues active. Utilities are buying a variety of plant and line equipment. Orders for turbo-generators have shown a substantial increase during recent weeks and inquiries are more numerous. Appliance sales are running ahead of deliveries.*

### NEW YORK

A new drive is being made by the government to prevent accumulation of unnecessary inventories. Manufacturers are finding the g oing tough in securing raw materials to keep production lines going at the speed of former months. A tighter squeeze is being anticipated.

Heavy electrical equipment sales continue at a fast pace as a result of the impetus of national defense. Curtailment of household appliances is likely to be accelerated by shortages developing in raw materials. Sales outlets report purchases well in excess of volume available for deliveries.

Machine tool shipments for May are estimated at $60,800,000, as against $60,300,000 for April and $57,400,000 for March. Shipments for May a year ago were estimated at $32,800,000.

Construction awards last week totaled $173,306,000, a new peak for the year, 24 percent higher than the week before and 80 percent above a year ago, according to report of *Engineering News-Record*. Public construction was the highest since the record week of October 17, 1940. Private awards were 50 percent under a year ago.

Electric utilities are buying turbo-generator sets, meters, regulators, transformers, capacitors, cable, switchgear, voltage regulators, substation equipment, circuit breakers and reactors.

In the Pittsburgh area business has again moved forward after the early June slump. Practically all of the ground lost has been regained. Power production continues the upward trend.

### NEW ENGLAND

Turner's Falls Power & Electric Co. plans to spend $998,957 on construction of 110-kv. and 66 kv. transmission lines, totaling about 42 miles, to supply power to the Springfield, Mass., area. In other localities in this district where industries are operating at full speed on defense orders utilities are preparing for the continuance of heavy calls on their power resources. Air type circuit breakers for transmission service are in greater demand.

Negotiations for heavy electrical marine equipment feature the status of the electrical market due to the wealth of orders for all types of craft placed in every New England yard available for the construction of ships for the government. Orders for small motors continue uninterrupted, with a steady flow of calls for machine tools.

Orders for metal products are holding up well in Connecticut and Rhode Island. Kennecott Wire & Cable Co., Phillipsdale, R. I., has received an order for switchboard cable amounting to $7,835 and Holtzer Cabot Electric Co., Boston, has been awarded a contract for inverters costing $48,000.

Construction of new housing projects has resulted in a strong demand for distribution transformers and domestic service meters. Electric furnace builders report commitments for steel-treating units which will keep them busy on full time into fall. Permits for the installation of oil-burning units in the Boston area are well in excess over those for the first six months of 1940. Inquiries for institutional electric cooking apparatus are noticeably more numerous. Appliance sales are steady and at present are responsive to the improvement in employment conditions in this area.

### CHICAGO

Sale of electrical equipment in this area continues at an exceptionally high level. Nearly all manufacturers report a steady flow of incoming orders for a wide variety of equipment. Utility buying continues in good volume as construction programs are being carried forward as rapidly as possible. Expansion of industrial plants is requiring a large volume of electrical apparatus.

Retail trade in the area is holding up remarkably well, with department store sales showing an increase of 13 percent over a year ago. Dealers report good acceptance of electric appliances, especially refrigerators, washers and roasters. Lighting equipment sales are running well ahead of last year, with fluorescent easily the most popular.

Republic Steel Co. has ordered two new 50-ton electric furnaces. Anaconda Wire & Cable Co. received an order from the Signal Corps for wire costing $532,000. Midland Machine Co. will spend $100,000 for new machinery for the manufacture of pumps.

Inland Steel Co. placed an order for control equipment to cost approximately $40,000. Electrical permits issued show considerable activity, installing motors, transformers, additional outlets and fixtures. Electrical power output in Chicago and suburbs last week rose 3,366,000 kw.-hr. over the previous week, a gain of 15 percent over the same period last year.

### PACIFIC COAST

Far-sighted preparations by the utilities in this section to cope with anticipated new peaks in new heavy industrial and housing areas have occasioned large purchases of electrical machinery, typical orders covering $50,000 switches and reactors, an 18,750-kva. G. E. transformer, costing $60,000, and $25,000 of subway transformers. Similar orders for Hawaiian Islands cover $95,000 switchgears, $10,000 cable, 22,000 transformers and a $15,000 street lighting installation. A $180,000 shipment to Mare Island navy yard covered two 300-kv. generators and three each 1,200- and 1,667-kva. transformers. Bay region shipyards accounted for six substations, costing $95,000, and $22,000 special cable.

Lighting business has included five California minor league ball parks, airport lighting installations in four Arizona fields, averaging $25,000 each, and $35,000 installations at Wenatchee, Wash., and Las Vegas, Nev. Los Angeles has requested bids for a 65,000-kw. steam turbine generating unit and six 30,000-kva. transformers for its Wilmington steam plant.

# HERE'S REAL *DUCT ECONOMY*

### *Economy at installation*

Savings are immediate when you use Transite Ducts. Made of asbestos and cement, Transite *Conduit* is so strong that no protective casing is needed underground. And, on exposed locations, its light weight, 10-foot sections and simple assembly speed up work, cut costs. Where an encasement is required, Transite *Korduct* provides maximum duct economy. Thinner-walled than Transite Conduit, otherwise identical, its long lengths cut down the number of spacers needed, mean fewer joints. And because both these better ducts have a permanently smooth bore, cable pulls are easily made not only at installation, but also during replacements even after years of service.

### *Economy in maintenance*

Completely fireproof, Transite Ducts minimize burnout troubles . . . won't generate dangerous fumes or gases. On concreted-in work, they actually provide extra fire protection between cables. In all cases, maintenance stays low, for Transite Ducts won't rot or rust, offer unusual resistance to weather and corrosion.

### *Economy in cable operation*

Increased system efficiency features every Transite Duct installation. Transite's high rate of heat dissipation provides greater system capacity or the lower cable operating temperatures that result in decreased copper losses, and longer cable life.

**If you are not now taking advantage of the new economies in distribution made possible with Transite Ducts, may we send you full details? Write for brochure DS-410. Johns-Manville, 22 E. 40th St., New York, N. Y.**

**JM Johns-Manville**

## TRANSITE DUCTS

**TRANSITE CONDUIT** . . . for exposed work and for installation underground without concrete encasement.

**TRANSITE KORDUCT** . . . for installation in concrete. Thinner-walled, lower-priced, but otherwise identical with Transite Conduit.

# NEWS ABOUT PEOPLE

## San Diego Gas Announces Executive Promotions

Three executive promotions have recently been made in the San Diego Gas & Electric Co. L. M. Klauber, formerly vice-president in charge of operation, becomes vice-president and general manager. H. R. Peckham, formerly general superintendent, succeeds Mr. Klauber and E. D. Sherwin advances from assistant general superintendent to general superintendent.

Mr. Klauber is a native of San Diego and a graduate in electrical engineering from Stanford University. Following two years in the Westinghouse apprentice course in East Pittsburgh, he returned to San Diego, where he became a salesman for the local utility company. Subsequently he became engineer of records, superintendent of the electric department, general superintendent and since 1932 vice-president in charge of operation. He is a past-president of the Pacific Coast Electrical Association and the Pacific Coast Gas Association.

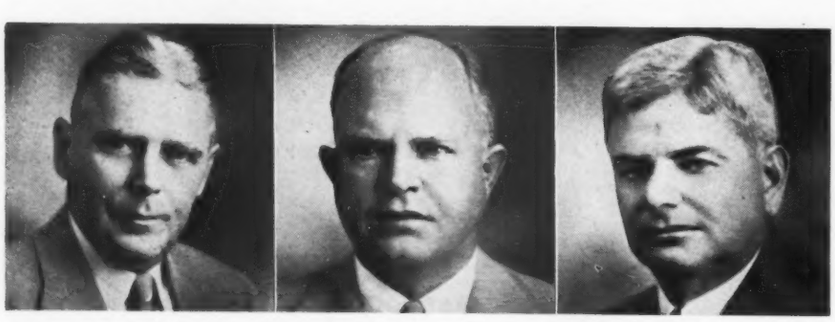
Mr. Peckham started work with the company in 1912 in the record department. During the World War he served as a captain in the 318th Engineers. Following the war he went with the Tacoma (Wash.) Gas Co. as assistant general superintendent. In 1921 he returned to San Diego in a similar capacity. In 1932 he was made general superintendent.

Mr. Sherwin's career with the company started before his graduation from Stanford University, when he worked summer vacations in the record department. After serving as a lieutenant of engineers in the war, he went with the U. S. Reclamation Bureau, rejoining the San Diego company in 1920 as a surveyor. His rise was rapid. In 1922 he was made assistant superintendent of electric distribution. Two years later he assumed similar responsibility for electric production and in 1932 became assistant general superintendent.

•

▶ CAMPBELL WOOD has been appointed manager of Nash-Kelvinator Corp.'s new airplane propeller division, which is now being set up in Lansing, Mich., to manufacture propellers for army and navy bombers. Mr. Wood has been with Nash-Kelvinator since shortly after the first world war and has held a number of executive positions with the corporation.

▶ ROGER G. MOSSCROP, executive assistant, Public Service Co. of New Hampshire, has been elected a vice-president. Mr. Mosscrop is a graduate of Massachusetts Institute of Technology in chemical engineering, and before becoming associated with the Public Service Company, about fifteen years ago at the time of its organization, was connected with the United Gas Improvement Co. organization for four years in Iowa and at Manchester, N. H.



E. D. Sherwin | H. R. Peckham | L. M. Klauber

## G. C. Tenney New Head of Pacific Coast Group

George C. Tenney, newly elected president of the Pacific Coast Electrical Association, has been active in the electrical industry of the far West since 1921. In that year he joined the staff of the *Journal of Electricity;*

since 1930 he has been editor of its successor publication, *Electrical West.*

Born in Utah in 1898, he has lived in California since 1902. He was a member of the University of California electrical engineering class of 1920. A member of the board of directors of the Pacific Coast Electrical Association since 1930, Mr. Tenney has held several committee appointments in the organization. In addition he is a former director of the Pacific Coast Electrical Bureau and past-president of the San Francisco Electric Club. At the present time he is treasurer of the Northern California Electrical Bureau and vice-president of the McGraw-Hill Company of California.

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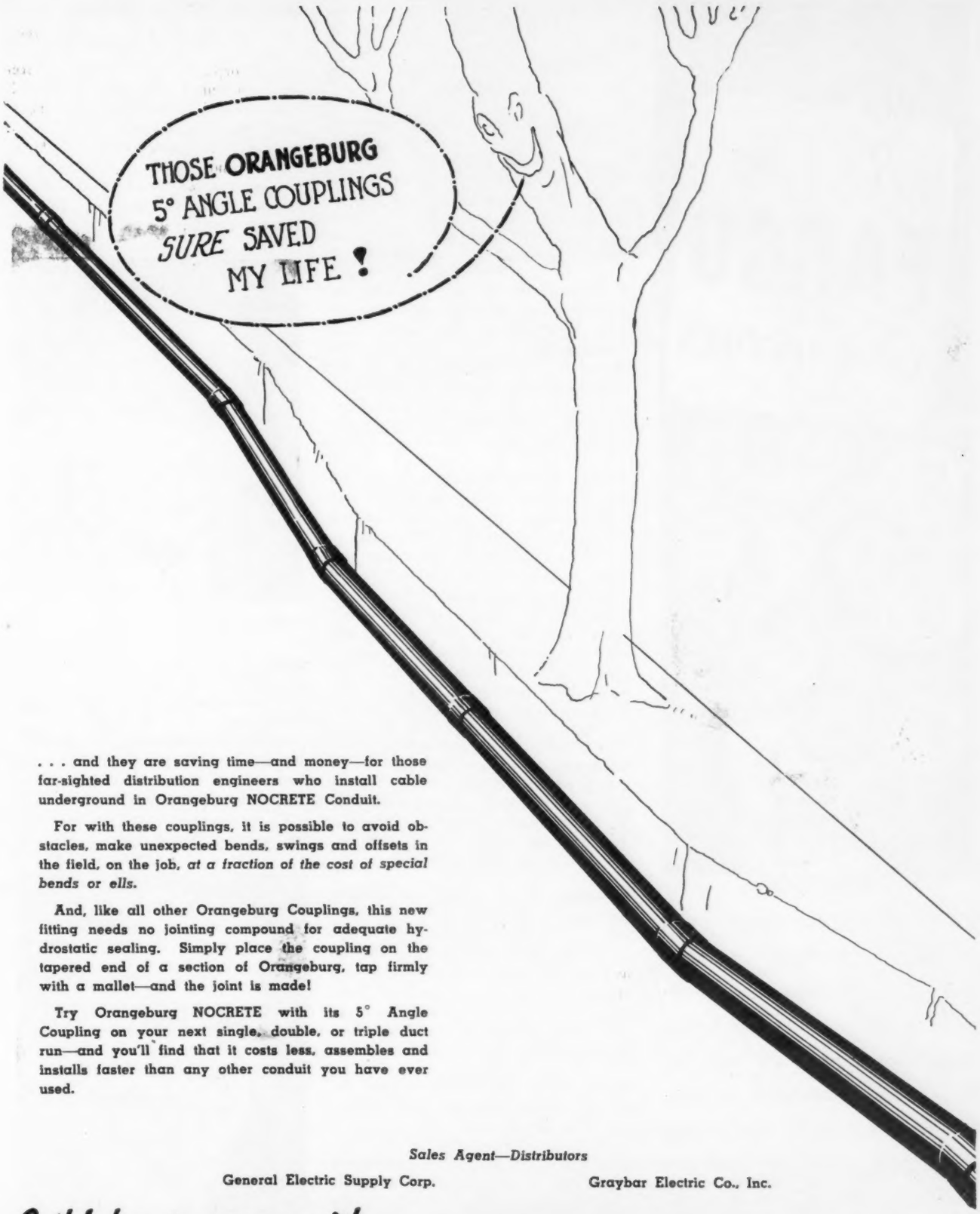
▶ J. W. BARKER, dean of engineering, Columbia University, New York, has been appointed special assistant to the




. . . and they are saving time—and money—for those far-sighted distribution engineers who install cable underground in Orangeburg NOCRETE Conduit.

For with these couplings, it is possible to avoid obstacles, make unexpected bends, swings and offsets in the field, on the job, *at a fraction of the cost of special bends or ells.*

And, like all other Orangeburg Couplings, this new fitting needs no jointing compound for adequate hydrostatic sealing. Simply place the coupling on the tapered end of a section of Orangeburg, tap firmly with a mallet—and the joint is made!

Try Orangeburg NOCRETE with its 5° Angle Coupling on your next single, double, or triple duct run—and you'll find that it costs less, assembles and installs faster than any other conduit you have ever used.

*Sales Agent—Distributors*

General Electric Supply Corp. Graybar Electric Co., Inc.

*Build for tomorrow with*

# ORANGEBURG *Conduits*

MADE AT ORANGEBURG, NEW YORK, BY THE FIBRE CONDUIT COMPANY, 292 MADISON AVENUE, NEW YORK CITY

ORANGEBURG NOCRETE for installation without concrete encasement
*Standard* for installation with concrete encasement

Time after time, year after year you can re-use the FARGO Connector and get a high pressure, vibration-proof contact. Fargo Everdur bodies and Duronze bolts are ruggedly built, precisely machined to withstand the strains of service and weathering, and retain *indefinitely* their famed ability to "grip like a vise".

*Made by FARGO MFG. CO.*
*Distributed by*

**LINE MATERIAL CO.**
MILWAUKEE, WIS.


Undersecretary of the Navy, Washington, D. C. Dean Barker was recently elected to the executive committee of the council of the American Association for the Advancement of Science.

▶ GEORGE W. BORG has resigned as chairman of the Borg-Warner Corp. because of the increasing burden of other duties in connection with national defense. Mr. Borg's responsibilities as chairman will be assumed by C. S. Davis, president. Directors voted to discontinue the position of chairman.

▶ JOHN A. ROESE, JR., has been appointed as a sales specialist for the new Westinghouse laundromat with headquarters in Pittsburgh, Pa. Mr. Roese was formerly manager of the Modern Electric Home, a Westinghouse dealer, in Meadville, Pa. He has been engaged in sales work for Pennsylvania firms for 34 years.

▶ FRED W. BROCKHOFF has assumed new duties as safety engineer of the Union Electric Co., St. Louis, Mo., a new position created by the company to co-ordinate the accident prevention program throughout the Union Electric System, covering a territory embracing properties in three states—Missouri, Illinois and Iowa. Mr. Brockhoff, who until his recent appointment, was a general foreman in the substations division, has been closely identified with the company's safety program.

▶ J. NELSON STUART, formerly advertising and sales promotion manager of the Kelvinator division of the Nash-Kelvinator Corp., is now connected with the network sales staff of the Columbia Broadcasting System as sales representative in the Detroit office.

▶ GARDNER COLE, commercial electric cooking specialist and sales representative of the Edison General Electric Appliance Co., Inc., with headquarters at Boston, has been given an enlarged territory to include upstate New York and Connecticut in addition to his present district embracing the other New England states.

▶ EDWARD B. NEWILL, since 1937 assistant general manager of Frigidaire and from 1930 to 1937 the company's chief engineer, has been appointed assistant to E. R. Breech, vice-president of General Motors Corp. EDWARD R. GODFREY, formerly head of Frigidaire's manufacturing division, has been appointed assistant general manager of Frigidaire division to succeed Mr. Newill. MASON M. ROBERTS has relinquished his position as superintendent of Frigidaire's Moraine City plant to become manager of plants. He will have supervision of all manufacturing operations.

## Buffalo Utility Makes Executive Assignments

Arthur W. Jackson, assistant treasurer of Buffalo Niagara & Eastern Power Corp., has been elected treasurer of that corporation to succeed George J. Brett, recently moved to New York to take up his duties as controller of Niagara Hudson Power Corp. (ELECTRICAL WORLD, May 24, page 17).

Laurence W. Buchanan, assistant

**A. W. Jackson**

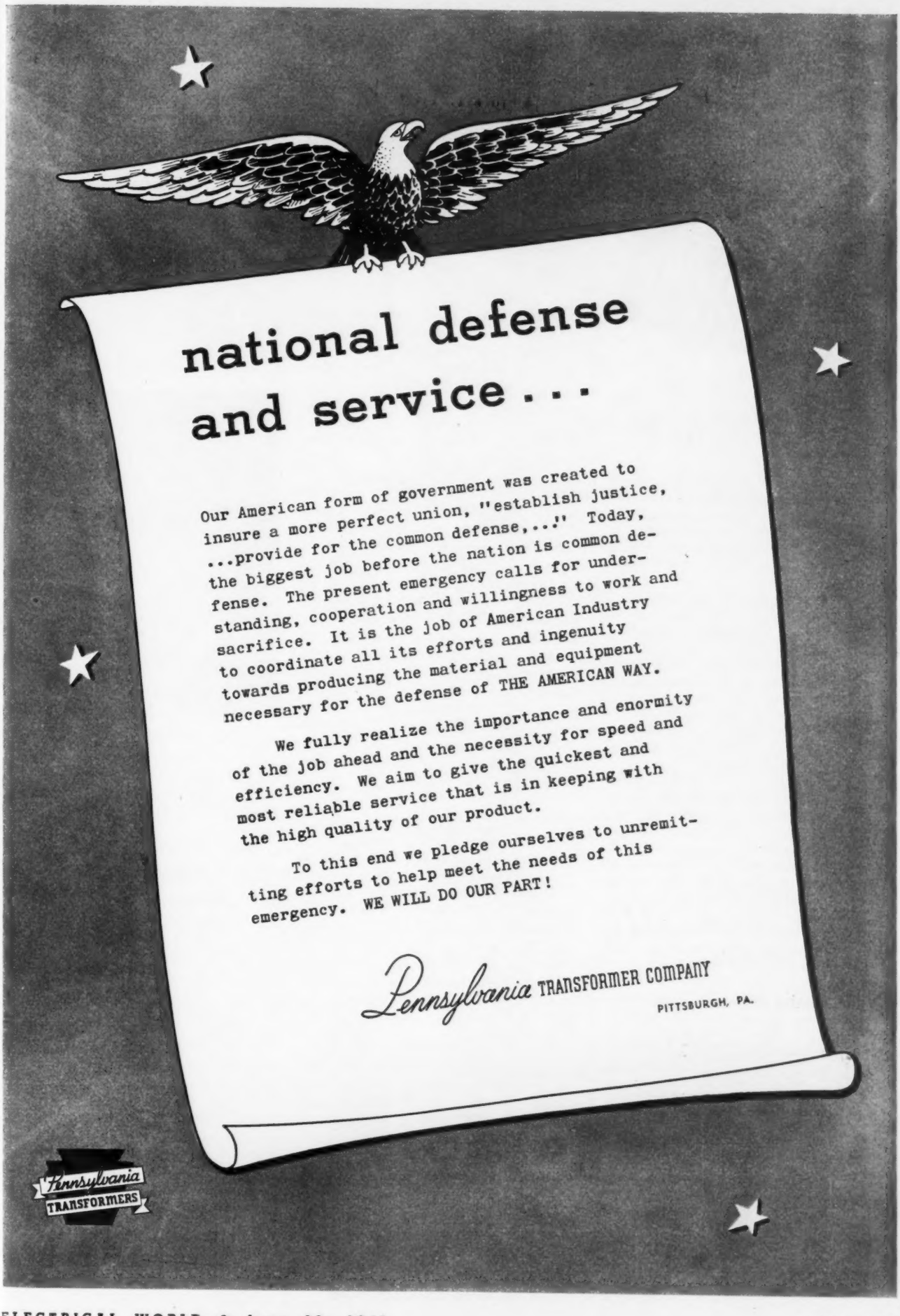
treasurer of Buffalo Niagara Electric, will succeed Mr. Jackson as assistant treasurer of Buffalo Niagara & Eastern Power Corp.

Harold R. Waldron, vice-president of Buffalo Niagara Electric Corp., has been elected vice-president of Buffalo Niagara & Eastern Power Corp.

Mr. Jackson has been associated with the electric utility industry since 1923,

**H. R. Waldron**

when he joined the Niagara Falls Power Co. as tabulating department supervisor. Five years later he was made tabulating supervisor for Buffalo Niagara & Eastern Power Corp. in Buffalo. In 1931 he became chief com-


national defense
and service . . .
Our American form of government was created to insure a more perfect union, "establish justice, ...provide for the common defense,...." Today, the biggest job before the nation is common defense. The present emergency calls for understanding, cooperation and willingness to work and sacrifice. It is the job of American Industry to coordinate all its efforts and ingenuity towards producing the material and equipment necessary for the defense of THE AMERICAN WAY.
We fully realize the importance and enormity of the job ahead and the necessity for speed and efficiency. We aim to give the quickest and most reliable service that is in keeping with the high quality of our product.
To this end we pledge ourselves to unremitting efforts to help meet the needs of this emergency. WE WILL DO OUR PART!
Pennsylvania TRANSFORMER COMPANY
PITTSBURGH, PA.
Pennsylvania TRANSFORMERS

HIGH in strength
LOW in cost
LONG in service life
SHORT on corrosion

Reliable
STRAIGHTLINE
SPLICES

via GraybaR

When you are looking for quick, long-lasting splices, you can rely on *Reliable*. These Straightline Splices are designed so that *if the lineman can put the wire into the splice the wire is there to stay.*

The splice is not subject to failure due to inserting burred, crushed or oversized wires — it will not permit a wire to screw out with the light, twisting pull which so often occurs when stringing wire. Electrically, it is as good as the wire itself . . . even at very slack span tensions. It runs cooler than the wire on overloads.

When you go to GRAYBAR for pole line needs like these, you get other benefits as well. You get frank, competent assistance on every requirement. You can choose from the finest products of more than 200 leading manufacturers, filling *all* your needs from a single source. For satisfaction from beginning to end, make your next order read "via GRAYBAR."

**RELIABLE SPLIT-BOLT CONNECTORS**

are also available from GRAYBAR. These connectors stay in one piece, eliminating dropping of nuts. Simply installed — hinge opens wide automatically as nut is removed. The hinge clips out of the way and may be used repeatedly. Ask GRAYBAR for the story on these time-savers.

*Executive Offices:*
Graybar Bldg.
New York

Distributed and guaranteed by
GraybaR ELECTRIC COMPANY
GraybaR
IN OVER 80 PRINCIPAL CITIES

mercial accountant and one year later assistant treasurer.

Mr. Waldron has been in electric utility work for a period of 33 years. He has held successive positions in the engineering department of electric companies in New York State and in 1938 was elected vice-president of Buffalo Niagara Electric Corp. In 1940 Mr. Waldron was named manager of operation for western division companies of the Niagara Hudson System.

Mr. Buchanan has been connected with associated companies of the system since 1919.

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▶ ROBERT L. CLAUSE, executive vice-president, has been elected president of the Pittsburgh Plate Glass Co. to succeed H. S. WHERRETT, who became vice-chairman of the board of directors, a new office. Mr. Clause has been identified with the company since 1914. Mr. Wherrett has served the company since its organization in 1891.

▶ LAWRENCE E. BARRINGER, General Electric engineer of insulations, has been awarded the honorary degree of doctor of science by Alfred University's New York State College of Ceramics. Dr. Barringer has spent a lifetime in the study of insulations and porcelain compositions. He has been granted 25 U. S. patents, covering insulating and ceramic compositions. In 1915 he was awarded a silver medal by the Panama-Pacific Exposition for his exhibit on insulation. The Lamme Medal, given by Ohio State University to a graduate "for meritorious achievement in engineering of the technical arts," was conferred upon him in 1940.

## OBITUARY

▶ CHARLES A. HUNTER, formerly general purchasing agent of the Canadian Westinghouse Co., Hamilton, Ont., died on June 10. Mr. Hunter was born in Pittsburgh, Pa., and became identified with Westinghouse Air Brake Co. 53 years ago. He went to Hamilton when the Canadian branch was opened, in 1898, and had been general purchasing agent for 40 years, when he retired three years ago.

▶ REUBEN E. NYSWANDER, dean of the school of science and engineering, University of Denver, Denver, Colo., died April 8. He was born in 1878 in Antwerp, Ohio, and was educated at Indiana University. He received the degree of doctor of philosophy from Cornell University in 1908. He started his academic career at Indiana University and later joined the teaching staff of the University of Denver. In 1919 he was made director of the school of electrical engineering, and when it was reorganized into a combined school of science and engineering he became associate dean of the department. He was made dean in 1937. Dean Nyswander was chairman of the Denver section of the American Institute of Electrical Engineers, 1931-32.

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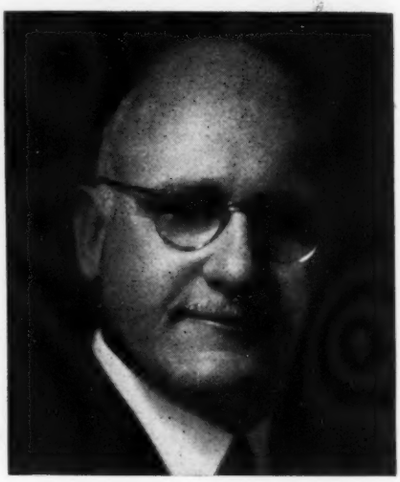
### Guy A. Barker

Guy A. Barker, manager of the public utility and electrical products department of Johns-Manville Corp., who died on June 18 (ELECTRICAL WORLD, June 21, page 10), was born in Palmer, Neb., fifty years ago, and was graduated from the University of California.

Before joining Johns-Manville, in 1921, he was associated with the Pacific



Gas & Electric Co. in San Francisco; with the Central Teresa Sugar Co. of Cuba as chief engineer, and later with the Industrial Accident Commission of California as chief mechanical engineer.

He joined Johns-Manville as a sales engineer, later serving as Pacific division sales manager, a Chicago district sales manager and later as manager of the electrical products department in New York. He was made manager of the public utility and electrical products department last April.

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▶ PROF. SIDNEY A. REEVE, retired consulting engineer, who held the chair of steam and hydraulic engineering at Worcester Polytechnic Institute from 1896 to 1906, and prominent writer and lecturer on engineering topics in later years at Harvard University and the U. S. Naval Academy, died at Nyack, N. Y., on June 12. He was born at Dayton, Ohio, 75 years ago and was graduated from Sheffield Scientific School in 1885. He practiced engineering for many years apart from his academic connections.

## Four-State Co-op Allotted $200,000

Rural Electrification Administration has announced that the President has allotted, through REA, $200,000 to permit construction to start on a co-operative transmission system to carry power from the Pensacola Dam to REA distribution co-operatives in four states. The new lines are necessary to provide power to develop zinc deposits, badly needed in national defense. An Army camp may also be a major consumer.

This allotment is made to the KAMO Electric Co-operative, with headquarters at Vinita, Oklahoma. It is the second partial allotment for the co-operative transmission system. An REA allotment of $58,000 last month permitted engineering work to proceed, but exhausted available REA loan funds.

The ultimate cost of the transmission system will be about $1,500,000. It will make power from the Pensacola Dam across the Grand River available to fifteen member REA distribution co-operatives located in Kansas, Arkansas, Missouri and Oklahoma.

Other allotments recently announced by REA follows:

IOWA—Pella Co-operative Electric Association, Pella, $25,000 for 30 miles of line, 75 members in Mahaska County.

MAINE—Union River Electric Co-operative, Inc., Aurora, $17,000 to complete the system.

SOUTH DAKOTA—Black Hills Electric Association, Inc., Custer, $72,000, a partial allotment to permit construction to start on 187 miles of line, 565 members in Pennington and Custer counties.

MISSISSIPPI—Four County Electric Power Association, Columbus, $4,000 for the completion of a refrigeration plant.

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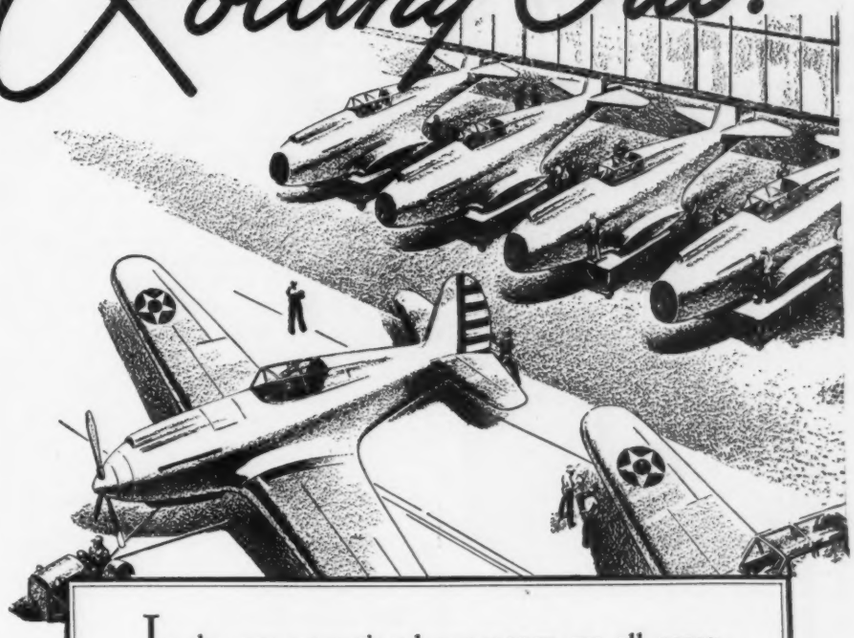
## Report Substantial Gain in Residential Uses

An analysis of residential customer consumption for 1940 has been made by Jay Goodman of the business development department of the Northwestern Electric Co., Portland, Ore. After eliminating apartment house dwellers, it was found that the average per customer in that year was 1,679 kw.-hr. If all home users had been included the average would have been 1,529 kw.-hr. per customer, which is 60 percent above the national average.

Mr. Goodman contends that apartment house customers, representing about 25 per cent of the total, maintain about the same load level year after year. Therefore, to get a true gauge of progress, it is necessary to base calculations on the three-quarters who can be reached by load-building activities.


TO KEEP THEM *Rolling Out!*



In the present national emergency, we all agree DEFENSE COMES FIRST!

An unending avalanche of planes, ships, guns, ammunition, machinery, equipment, supplies must roll out from the production lines at ever-increasing momentum.

Roebling has geared up its electric wire and cable plant to meet the emergency. Day and night the wheels turn at top speed. Every fraction of capacity has been put to work. Electrical wires and cables in endless variety are streaming from the Roebling plant ready for defense duty.

Roebling appreciates the fine cooperation and understanding of valued customers who have experienced unavoidable shortages and shipping delays, caused by the unprecedented production situation.

JOHN A. ROEBLING'S SONS COMPANY

Trenton, New Jersey Branches in Principal Cities
Export Division: 19 Rector St., New York, N.Y., U.S.A.
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ROEBLING 1841 1941 100th ANNIVERSARY

ROEBLING
ELECTRICAL
WIRES AND CABLES

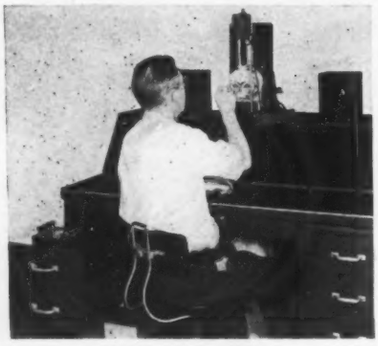
STATES TESTING EQUIPMENT

**WATTHOUR METER TESTING**

**by**

**STROBO**

[Operator adjusts meter while disc is in motion]



**What prominent Utilities say about STATES Strobo**

"STATES Strobo Units cut costs of testing to 1/3 former method."

"Our testing output of old meters increased from 15 to 40 meters per day by same man, same testing requirements; new meters showed similar increase."

***Either a Complete Strobo Test Table or Strobo Equipment to go on your Present Test Tables.***

**See *Bulletin* #309 or #310**

**TEAR OFF AND WRITE TO**

The STATES Company
Hartford, Conn.
Please send information on—

☐ Strobo Equipment for present test tables.
☐ Strobo Test Tables complete

NAME ..... TITLE .....
FIRM .....
CITY ..... STATE .....

# Sales Opportunities

MONROE, LA.—City Council receives bids until July 8 for steam-generating equipment for installation in municipal electric power plant, where expansion and improvements will be carried out. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

HUNTINGTON, W. VA.—Appalachian Electric Power Co., Roanoke, Va., has approved plans for new power substation at Eighth Avenue and Eighth Street, Huntington, and will begin work on construction at once. Station will be connected with incoming transmission lines and extensions will be made in system for that purpose.

ASTORIA, ORE.—Bonneville Power Administration, Guardian Building, Portland, Ore., has plans maturing for new 22,000-volt transmission line to connect power substation at Astoria with neighboring Naval Air Base and Coast Guard Base, respectively, of Federal Government, where power substations will be located for distribution service. New line will be about six and one-half miles long, of which about one-half mile will be underground. Cost estimated about $130,000, including transformers and accessories, switchgear, metering apparatus and auxiliary equipment.

ST. LOUIS, MO.—United States Engineers Office, Court House and Custom House, St. Louis, receives bids (no closing date stated) for 33,000/4500-volt power substation, including outdoor and indoor switch stations, for service at Jefferson Barracks, Mo., and Scott Field, Ill. Also for two boiler plants for respective fields.

BUFFALO, N. Y.—Buffalo Arms Corp., 537 East Delavan Avenue, Buffalo, affiliated with Houde Engineering Co., same address, both subsidiaries of Houdaille-Hershey Corp., Detroit, Mich., plans installation of motors and controls, transformers and accessories, switchgear, industrial lighting system, electric hoists, conveyors and other equipment in new one-story additions to plant now in course of erection at Cheektowaga, near Buffalo, for production of fire arms for Government. New structures will form an extension of original project and will be used for manufacture of aircraft machine guns. Cost about $10,870,000, including buildings and equipment, and fund in that amount will be provided by Defense Plant Corporation, Washington, D. C., Federal agency, for project.

LAKE CHARLES, LA.—Mathiesen Alkali Works, Inc., 60 East Forty-second Street, New York, N. Y., manufacturer of industrial chemicals, synthetic salt cake, liquid chlorine, etc., plans new steam-electric power plant at branch works at Lake Charles, and will carry out construction in conjunction with group of new buildings for production of metallic magnesium. Four large one and multi-story units will be built, including an electro-chemical plant, with installation to include motors and controls, switchgear, regulators, industrial lighting system, duct lines, electric hoists, conveyors and other equipment. Entire project is estimated to cost over $6,000,000. Work is scheduled to begin early in August.

SACRAMENTO, CALIF.—Bureau of Reclamation, Old Post Office Building, Sacramento, receives bids until July 14 for construction of Keswick Dam, Kennett Division, Central Valley project, Calif., including installation of gates and gate hoists, electrical metal conduit, electrical conductors, ground wires, ground rods, etc. (Specifications 960).

CHICAGO, ILL.—Commonwealth Edison Co. has approved plans for alterations and improvements in steam-electric power plant at Twenty-fifth and Quarry Streets, to provide additional oil-handling facilities and other work. H. C. Von Holst, 140 South Dearborn Street, is architect. Project will be placed under way soon.

LANSING, MICH.—Olds Motor Works, Division of General Motors Corp., has filed plans for new power substation at automobile works, for service for additional plant units. Cost estimated about $65,000. Erection is scheduled to begin at once.

SEWARD, PA.—Pennsylvania Electric Co., Johnstown, Pa., has plans under way for extensions and improvements in steam-electric generating station at Seward, primarily for expansion in steam department, with installation of new boiler unit and auxiliary equipment. E. M. Gilbert Engineering Corp., 412 Washington Street, Reading, Pa., is consulting engineer.

SALT LAKE CITY, UTAH—Remington Arms Co., Bridgeport, Conn., manufacturer of fire arms and ammunition, etc., a subsidiary of E. I. duPont deNemours & Company, Inc., Wilmington, Del., plans installation of motors and controls, switchgear, interior and exterior industrial lighting facilities, duct lines, conveyors, electric hoists, boiler plant for central-heating service and other equipment in new plant in vicinity of Salt Lake City for production of small arms ammunition for War Department, Washington, D. C., with which contract is being made for construction and operation of plant, to be owned by Government. A power substation will be built on plant site, now being selected, for power service. Entire project is estimated to cost about $30,000,000, including land, buildings and equipment, with fund in that amount to be furnished by Government.

MUSKEGON, MICH.—Central Paper Co., Inc., manufacturer of kraft, tissue and other paper stocks, plans extensions and improvements in power plant at mill, reported to cost olose to $100,000, including equipment. Capacity will be increased.

AURORA, ILL.—Western United Gas & Electric Co., Aurora, is arranging immediate call for bids for construction of proposed addition to local steam-electric generating station, including improvements in present structure, to provide for installation of a new turbine-generator unit and auxiliary equipment, previously referred to in these columns. Cost reported over $500,000. This is part of 1941 expansion program of company. Sargent & Lundy, Inc., 140 South Dearborn Street, Chicago, Ill., is consulting engineer.

## Recent Rate Changes

WISCONSIN MICHIGAN POWER CO. has announced a rate reduction effective with the June electrical consumption totaling $21,000 annually and affecting more than 4,800 commercial and small industrial customers. The reduction applies to all areas served by the company. In Wisconsin 3,382 customers will benefit and in Michigan 1,461 users will receive lower bills.

ILLINOIS COMMERCE COMMISSION has announced that utility rate changes effective during the month of May, 1941, in the State of Illinois, resulted in an estimated decrease of $15,830 in annual operating revenues. Electric rate reductions contributed $15,506 to this total.

SHELBY, OHIO, municipal light plant put into effect an electric rate cut of 20 per cent, amounting to an annual saving of approximately $10,000 to 2,200 consumers.

GRAND HAVEN BOARD OF PUBLIC WORKS, Grand Haven, Mich., has announced an electric rate reduction for residential consumers, effective June 1. The new rate follows: 4 cents per kilowatt-hour for the first 47 kw.-hr. used per month; 2 cents per kilowatt-hour for the next 133 kw.-hr. used per month; 1.5 cents per kilowatt-hour for the balance; minimum, 75 cents. The old rate was: 4.5 cents per kilowatt-hour for the first 25 kw.-hr. used per month; 3.0 cents per kilowatt-hour for the next 40 kw.-hr. used per month; 2.0 cents per kilowatt-hour for the next 125 hw-hr. used per month and 1.5 cents per kilowatt-hour for the balance; minimum, 75 cents. Commercial lighting and power schedules were also reduced.

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## Gets Navy Contract

Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded a contract to C. C. Moore & Co., 450 Mission Street, San Francisco, Calif., engineers and contractors, for extensions and improvements in power plant at Mare Island Navy Yard, Vallejo, Calif., at $900,000, including equipment installation.

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## Primary Load Up 7.4%

Hydro-Electric Power Commission of Ontario reports the primary load for all systems in May at 1,759,419 hp., against 1,637,932 hp. in May last year, an increase of 7.4 per cent. Primary and secondary loads for all systems totalled 2,055,104 hp., compared with 1,971,107 hp. in May, 1940, an increase of 4.3 per cent.

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## Allows Bonneville Rate

Federal Power Commission has approved a temporary rate of 4.861 cents per kilowatt-day for electric energy sold by the Bonneville Administration to Aluminum Co. of America for baking-out power for the company's third unit in the Portland, Ore., area.

**FRAHM VIBRATING-REED TACHOMETERS**

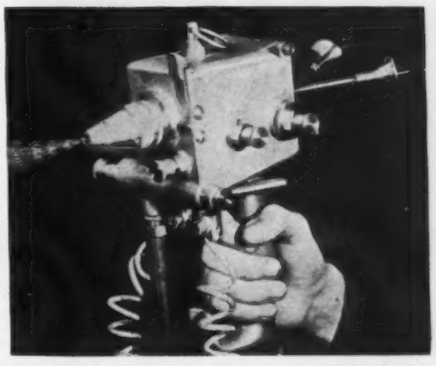
give continuous and reliable indications of speed without any contact whatsoever with the rotating shaft. Write for Bulletin 1590-W.

**James G. Biddle Co.**

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

*New!* **SCHOOP ELECTRO-PISTOL**

**METAL SPRAYING PROCESS**



**FOR MANUFACTURING MOLDINGS, MATRICES, DIES, ETC.**

**Dr. Schoop's revolutionary improvement over all previous metal spraying processes! Utilizing an electric arc, it facilitates operations previously impossible, such as spraying tungsten, molybdenum, chromium, etc. From 2½ to 10 times faster than gas spraying. Reduces costs in making moldings, matrices, dies, etc. as much as 80%! Uses 50v. x 200 amps; capacity 22-25 lbs. steel per hour weight. Approx. 3 lbs.**

*Typical Electro-Pistol Products*

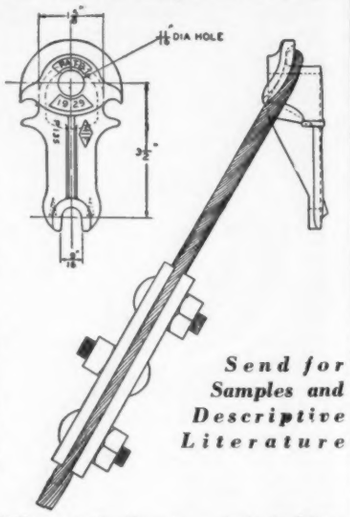
*Write (Airmail) or cable for information—TODAY!*

**M. U. SCHOOP** METALLIZING PLANT ZURICH 5. SWITZERLAND

CABLE ADDRESS, METALLISATOR, ZURICH

# Simplified Guying Specifications

**A new circular available on request features suggestions for Simplified Guying Specifications based on three simple galvanized malleable castings — M.I.F. P135 Through-bolt Guy Hook as illustrated, P128 Thimbleless Eye Nut, and P143 Curved Ribbed Washer — which users definitely rate equivalent to standard ⅝" bolts and guy strands with which they are used. A logical starting-point for Through-bolt Guying is provided when a ⅝" through-bolt constitutes the means for applying corner or dead-ending stresses against which pole must be guyed — then, using suitable attachment on other end of same bolt.**




Test competitively with present guying specifications by sending assorted trial order at following 100-lot F.O.B. Branford prices:

| | |
|---|---|
| P135 Guy Hook . . . $18.20/C | P126B Bolt Eye . . . $24.50/C |
| P128 Eye Nut . . . . 14.70/C | PA128-6 Anchor Rod 66.70/C |
| P143 Curved Washer 7.70/C | (⅝" x 6 ft. Thimbleless) |

Or, we will send sample P135, P128, and P143 without charge or obligation in response to request on Operating Company letterhead.

Use the Guy Hook for anchor guys, and the Eye Nut or Bolt Eye for pole to pole and other relatively flat guys, and the Curved Washer to minimize slotting or splitting stresses in the pole. Larger sizes available for heavier service. More than 1,000,000 successful M.I.F. Guy Hook installations prove these specifications are practical.

*Send for Samples and Descriptive Literature*

**Misc. M.I.F. Pole Hardware Specialties:** — *Williams Pole Mounts — Pole Stubbing Clamps — Aerial Cable Messenger Clamps and Insulated Hangers — Malleable Secondary Racks and Clevises — Tubular Pole Fittings — Transformer Hanger Plates for Through-bolt Mounting — Malleable Crossarm Gains — Screw Anchors — Sidewalk Guy Fixtures and Alley Arm Braces — Guy Strand Dispensing Holders — Through-bolts and Double-arming Bolts, etc.*

**MALLEABLE IRON FITTINGS COMPANY**
Pole Hardware Dept. [ Factory and New England Sales Office ] Branford, Connecticut
New York Sales Office: Thirty Church Street
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LINE & CABLE ACCESSORIES, Ltd., Toronto

# GREENLEE BENDERS

## EASIER AND FASTER FOR THE MAN ON THE JOB

Ask the man who knows . . . the operator right out on the job doing the bending . . . and he'll tell you that bending conduit with the Greenlee Hydraulic Bender is even easier than it looks. To bend conduit requires power . . . approximately 31 tons for 4-inch conduit . . . and Greenlee Hydraulic Benders have the power. The No. 770 Bender, for 1¼ to 3-inch conduit, has 25 tons of easily developed power, while the No. 775 Bender for 3 to 4½-inch conduit, has 40 tons of hydraulic power. One man can quickly develop this power by simply pumping the handles. These light, portable benders are built compactly into one unit, are easily carried to the job and set up, and will not move and twist about when in use. Write today for our new S-116 Bender Booklet . . . it will show you how you can cut bending costs on every job.

The No. 770 Bender, shown above, is designed to make bends in 1¼, 1½, 2, 2½, and 3-inch conduit, while the larger No. 775 Bender will bend 3, 3½, 4, and 4½-inch conduit and pipe.

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.


## Commercial Cooking Adds Revenue of $135,000

[*Continued from page* 55]

summated, a permanent installation is made, for which the customer pays all costs involved. The company has a very rigid policy against any subsidy for wiring or other expenses involved in an installation, and under no circumstances will it bear any part of the installation cost. In cases where the equipment is sold through associated sales allies, the installation arrangements are made between the purchaser and the seller. When the company actually handles the sale of the merchandise the installation cost is invariably added to the list price of the equipment and the total cost of equipment and installation is billed to the customer without any concessions.

### *Competitive Field*

Competition is reasonably active throughout the territory as coal is available at about $8 per ton. Manufactured gas (540 B.t.u. content) averages 90 cents per 1,000 cu.ft. Bottled gas with 21,633 B.t.u. per pound is sold from 5 to 10 cents per pound, depending upon the volume of purchase and other factors. At present coal is the most widely used competitive fuel. However, bottle gas distributors have shown considerable activity which, however, has been counteracted by closer customer coverage by the company's commercial salesmen, who are armed with timely and accurate data relative to the advantages of electric cooking.

The efforts of commercial salesmen to popularize electric cooking are aggressively supported by a continuous direct mail advertising program which is based upon the use of photographs and testimonials from local installations. The use of localized material has proved far more effective in impressing customers and in creating buying interest than advertising material which pictures and describes installations outside of the territory.

Whenever an all-electric installation is completed photographs are taken of the kitchen and other parts of the installation and these pictures, along with a testimonial letter from the customer, are used in newspaper advertisements. Reprints are made of these advertisements for use in direct mail coverage and by salesmen as handout pieces on personal calls. This advertising procedure serves a dual pur-

pose: First, it reaches and influences all competitive food establishments in the vicinity of the new installation, and, second, it tends to create wider public acceptance of the fact that electric cooking is the modern way with many advantages which are reflected in superior food enjoyment.

### *Chain Stores*

Particular attention has been given to installations in the food departments of chain stores, and during the past year the greater majority of kitchen installations and luncheonette installations in the territory were all-electric. The effect of an all-electric installation in the cafeteria of a leading variety store, department store or similar business is very pronounced, and it has been found that such an installation will be speedily followed by increased interest in the adoption of electric cookery by competitive places of business.

As the majority of counter cooking and heavy-duty cooking equipment must essentially be sold to small establishments, the cost of the equipment once proved a deterring factor. However, this problem has been solved to a large extent by showing prospective customers carefully kept records of operating costs of installations and by presenting facts relative to the long life, low maintenance and superior performance of electric cooking equipment.

Through close contact with customers who are using all-electric equipment, some very interesting and impressive facts can be secured which can be well used in dealing with prospects and in offsetting some of their preconceived opinions. For instance, the records of one chain store which have been made available show that an all-electric luncheonette with 50 stools does the same volume of business as a 96-stool non-electric luncheonette located in one of the chain's nearby stores, and that the all-electric installation not only produces the highest average food checks but also an eighteen-minute customer turnover per stool during hours of peak operations. Such facts as these are of genuine interest to any one engaged in the food business, and it is facts of this kind that are depended upon to break down sales resistance on the part of prospects.

The step-by-step sales plan has an added advantage of stabilizing the load, as records based on sub-meter checks of complete electric kitchens show that 55 per cent of the monthly kilowatt-hour consumption is used by the counter-cooking appliances, which indicates that it is profitable to see that counter-cookery appliances are liberally used, which will invariably be the case when the step-by-step sales plan is used.

Due to the demand feature of the general service schedule, a separate meter is provided for cooking services in all cases where complete all-electric cooking installations, with heavy-duty cooking equipment, are involved. Lighting, refrigeration and miscellaneous power services are not allowed on this commercial cooking schedule number CC-2, which is as follows:

*Net Monthly Rate*

3.0 cents per kilowatt-hour for the first 30 kw.-hr. used per kva. of the contract kva.
2.0 cents per kilowatt-hour for the next 1,000 kw.-hr. used
1.0 cent per kilowatt-hour for all additional kw.-hr. used

*Net Minimum Monthly Bill*

$1 for each kva. of contract, but in no event less than 10 kva.

*Contract Kva.*

The contract kva. for billing purposes shall be the 15-minute integrated demand during current month, but not less than 80 percent of the maximum established for billing purposes during the preceding eleven months, or 75 percent of the amount contracted for.

Electric cooking is constantly gaining in popularity among institutions and commercial food establishments in the territory and the outlook for 1941 is very favorable, as far as new counter-cooking and heavy-duty cooking installations are concerned.

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## Ask Wholesale Rate Cut

Alabama Power Co. has asked the state Public Service Commission for authority to reduce its wholesale power rates to rural electric co-operatives, municipally operated systems and private utility companies. On the basis of 1940 consumption, the proposed cut would reduce company revenues from these customers by 6.8 per cent or a total of $16,689.

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## Seeks $700,000 Fund

Corporation Counsel A. C. Van Soelen, Seattle, has been asked by the City Council utilities committee to prepare an ordinance authorizing "City Light" to spend $700,000 to serve new customers. As planned, $300,000 will be used for merchandise to be sold for use on city electric lines and $400,000 to hook up these appliances to the municipal system.


The MOST COMPLETE LINE OF Service Connectors

LARGEST VARIETY of types, and a COMPLETE range of sizes. For all kinds of conductors.

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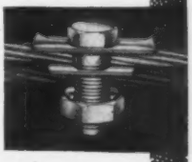

SERVICE POST Connectors for one or more conductors; many types.

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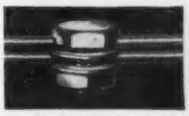

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Stewart IRON and WIRE FENCES

## Multi-Purpose Oil Refinery

[*Continued from page* 43]

they were separate machines. Operation of the main controlling valve on the high-pressure section is actuated largely by the pressure in the exhaust of the high-pressure section, with the back-pressure governor automatically reset by the pressure at the exhaust of the evaporators in such a way as to maintain a nearly constant 180-lb. pressure. The controlling valves for the low-pressure section, on the other hand, are actuated by the speed governor and hence are responsive to the load requirements.

Should load requirements be under the output of the high-pressure section when supplying the called-for steam, then the high-pressure controlling valves are closed a corresponding amount. The governor of the low-pressure section is arranged so as to permit holding these controlling valves open just sufficiently to supply cooling steam to the low-pressure turbine. Minor changes in the frequency in the system causes no variation in the opening of these valves, yet they are automatically opened to a predetermined limit in the event of a sudden reduction in frequency; *i.e.*, a demand on the system for load from this unit.

Performancewise, the high-pressure turbine is designed for a maximum flow of 675,000 lb. per hour and any part or all of this flow, with the exception of that required to cool the low-pressure turbine and the gland leakage, may be extracted. The operating back pressure is 240 lb. abs. Under these conditions the output is approximately 32,500 kw. The unit will also develop approximately 43,500 kw. with zero extraction; that is, with all of the flow passing to the low-pressure turbine. Under certain extracting and condensing conditions a maximum load in excess of 50,000 kw. can be carried.

The oiling system incorporates an innovation in the interest of safety. The high-pressure oil is conducted to the bearings and to the oil-operated hydraulic system by means of small pipes on the inside of the oil-drain returns from the corresponding bearings and hydraulic cylinders. In this way no high-pressure piping is exposed and the fire hazard is reduced.

Examination of the flow diagram shows that the high- and low-pressure steam cycles are kept separate in order to insure flexibility of operation and reliability of both the steam supply to the refineries and the power output of the plant. In the high-pressure steam cycle the condensate after leaving the deaerating hot well of the condenser is pumped through the jet condenser to contact heater No. 3, through closed heater No. 2 and to contact heater No. 1. Pumps indicated at contact heaters Nos. 3 and 1 are the booster pumps and boiler-feed pumps. They are on the same shaft and are driven by an auxiliary turbine. Each auxiliary turbine has a capacity of 1,675 kw. and drives, in addition to the pumps, an induction generator of 1,000 kw. capacity. At light loads the induction generator may be required to operate as a motor.

For the process-steam cycle the water is first treated by water softeners. It then passes through the feedwater heating section of the condenser, heater No. 7 and then to the deaerating heater No. 6. From heater No. 6 the evaporator feed pump passes the water to the evaporators. The evaporator-feed pump and the evaporator-condensate pump are on the same shaft and are driven by a single motor.

### *Make-up Condenser*

The make-up condenser is used to furnish make-up to the high-pressure steam cycle. It is regulated by throttling the steam supply to heater No. 5. Condensate from the make-up condenser is pumped to contact heater No. 1. Provision is made so that, should this be more than the boilers require, condensate will be withdrawn at a point just beyond the jet condenser. An auxiliary deaerating heater No. 8 is installed to deaerate the distilled water from storage before it is returned to the high-pressure steam cycle.

In addition to the usual complement of turbine instruments and gages there are four supervisory equipments provided to assist the attendant in starting and running the turbine. They are: (1) eccentricity recorder; (2) vibration amplitude recorders located on five bearings; (3) expansion detector, and (4) two interference detectors located on the turbine shell. These instruments are mounted on the engineer's switchboard.

[*A subsequent installment will discuss the electrical features of these plants.*]

## A.I.E.E. Talks Transmission, Breakers, Meters, Relaying

[*Continued from page* 59]

impulses of more than average field severity.

**Bushing Tests.** By **A. L. Brownlee** and **W. H. Wickham** (both Commonwealth Edison).

Power-factor tests on bushings at voltages equal to or above the operating voltage have shown defects in new bushings which would not have been found by low-voltage tests. Gives results of tests at higher voltages and describes nature of deterioration in bushings as found by laboratory examinations of bushings with high power factor.

Comment on the Komives paper indicated a general disposition toward favorable consideration of maximum stress as more useful than average stress in stating impulse strength of cable insulation. However, as was pointed out by J. A. Scott (General Electric), K. S. Wyatt (Phelps Dodge) and Herman Halperin (Commonwealth Edison), there are so many other factors affecting cable insulation quality as to prevent any one characteristic from being accepted as a definitive measurement of it. Wyatt: "The impulse strength should be used in measuring cable quality only when complete details of construction are known and sufficient test data are available." Scott: "It seems scarcely logical to use impulse breakdown tests as rigid criteria of cable quality." Halperin: "For predicting the serviceability of a cable, accelerated aging tests seem to be of first importance."

J. B. Whitehead (Johns Hopkins) agreed as to the greater importance of maximum than average stress, but felt that the present evidence of it was insufficient and should be reinforced by more comprehensive laboratory experimentation. L. F. Roehmann (Anaconda) said that in dielectric stress as in mechanical calculations average values have no physical significance. General agreement of Mr. Komives' results with those obtained by much earlier investigators was stated by W. A. DelMar (Habirshaw), who warned, however, that the laws governing impulse strength will not be fully understood until many more data are available.

Discussing Mr. Doble's paper, Gordon B. Tebo (Ontario Hydro-Electric) instanced the satisfactory experience in Canada with the potential gradient method of insulation testing and suggested that practice in the United States, which has largely abandoned this method, did not give it sufficient trial. E. D. Doyle (Leeds-Northrup) regretted that in choosing a name for his method of testing Mr. Doble did not select a more accurately descriptive one than "power factor."

Experience has demonstrated, said P. L. Bellaschi (Westinghouse), in commenting on the MacCarthy and Carpenter paper, that dependable conclusions on transformer insulation and protection can be reached only by comprehensive tests on the complete apparatus. V. M. Montsinger (General Electric) stated that the results obtained by the authors agreed well with data he had secured from testing thicker barriers. Herman Halperin (Commonwealth Edison) thought that the type of electrode used in the tests made interpretation of the results rather difficult.

Skepticism of wide practicability of high-voltage bushing testing as described by Brownlee and Wickham appeared in comments that such tests belonged in the factory and not in the field (I. W. Gross, American Gas & Electric); the equipment was too big for easy portability (E. A. Walker, University of Connecticut); the hot-stick method was lots easier and nearly as useful (Gordon B. Tebo, Ontario Hydro-Electric). L. Wetherill (General Electric) believed that most instances of compound migration would be found to be in older bushings, and C. F. Hill (Westinghouse), while admitting the presence of very small voids in bushing insulation, did not think that ionization in them could be severe enough to cause serious trouble.

## Electrical Machinery

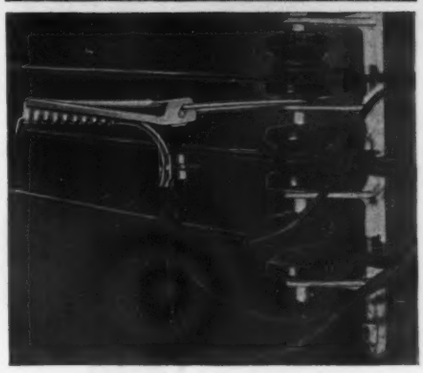
**A New Transformer for Base-Load Stations.** By **Philip Sporn** (Amer. Gas & Electric Service) and **H. V. Putman** (Westinghouse).

Hipersil cores in three 138-kv., 40,000-kva. units for Philo station. Savings in weight and dimension. Shipped in oil ready to operate. Forced-oil and forced-air cooling. Copper temperature relays. Little overload capacity necessary (base-load station). Cover welded, hermetically sealed, no provision for breathing.

**Excitation Circuits for Ignition Rectifiers.** By **H. C. Myers** and **J. H. Cox** (both Westinghouse).

Thyratrons provide flexibility and speed of response superior to elements depending on mechanical movement or inductive change of current. Saturating reactor elimi-


**A PRACTICAL WAY TO SUPPORT CABLE**



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| 5395 | 5/8" | 1" | 7/8" x 5/8" | 1" x 7/8" |
| 5666 | Clevis and Pin | | | |
| 5667 | Clevis and Bail | | | |

Right now, all of the clamps listed above, are still substantially low priced with quantity discounts providing further savings. A trial order for $25.01 or more will give convincing proof that it pays to use Kearney Dead-End Service Clamps . . . Write — **James R. Kearney Corporation, 4236 Clayton Avenue, St. Louis, Missouri — Canadian Plant, Toronto, Canada.**

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nates tube replacement and offers practical advantages and when used with phase-shifting network can be controlled with small power devices.

Commenting on the Sporn and Putman paper, F. J. Vogel (Westinghouse) traced the development of thinking on forced cooling of transformers from air blast to mechanical circulation of oil, concluding that experience with such transformers in central station use where losses and overload capacities were not important considerations and where attendance was available, would in time make this type quite common. E. D. Treanor (General Electric) referred to developments in Spirakore transformers, pointing out that "there are some transformer characteristics that require careful consideration before taking full advantage of the best saturation, magnetizing current, loss and magnetostriction available in the steel." The author's reference to the possible extension of size of portable power transformers using Hypersil was concurred in by E. V. DeBlieux (General Electric), who said that the mobile substations built by his company have transformers with "cores made of high permeability, highly oriented cold-rolled silicon steel that operates at appreciably higher (than former) density."

Critical of the paper's failure to include "any fundamental or even engineering development data on the steel used in the transformer core, Philip Sporn, one of the authors, said that nevertheless the paper proves there is no occasion for pessimism as to progress so long as engineering thought is free to exercise its God-given talents and abilities. In closing the discussion, Mr. Putman gave emphasis to the importance of improved core steel by saying that mobile substations of capacities up to 100,000 kva. had been built in the warring countries of the Old World.

Agreement on the entire practicability of tubeless circuits for igniters in mercury-arc rectifiers, such as described in the Meyers and Cox paper, was expressed by C. C. Herskind (General Electric). But although thyratrons are inherently devices of limited life, said O. W. Pike (General Electric) the life of the tube is really very long, practically. Therefore much of the objection to use of thyratrons in power equipment, such as rectifier igniter circuits, disappears. Mr. Meyers agreed on this point and remarked that much of the appeal of the tubeless circuit was probably psychological.

## Power Metering

**Effect of Sapphire Crystal Orientation on the Wear of Watt-Hour Meter Bearings.** By **J. H. Goss** (General Electric).

Wear of lower (sapphire) bearing estimated for 150 bearings in meters which had been run for five to six years. Orientation of crystal axis determined by means of polarized light. Wear found to increase as jewel orientation increases from 90 to 0 deg. Synthetic sapphire orientation more readily controlled between desirable limits of 80 to 90 deg.

**An Improved Frequency Meter for Commercial Power Frequencies.** By **K. J. Knudsen** (Hickok).

Eliminates customary external reactor by using an iron core cross-coil instrument, the iron core likewise shortening the high reluctance air gap necessary for the moving coils. Consumes only 0.8 watt at 115 volts. Accuracy better than 0.2 cycle at 60, with permissible third harmonic of 10 percent, voltage 90-140 and ambient —10 to +40 deg. Instrument circuit p.f. = 0.97.

**Power Circuit Instruments for the Higher Range of Audio Frequencies.** By **L. J. Lunas** and **Paul MacGahan** (both Westinghouse).

Heat-treatment and induction furnaces require instruments having heavy overload capacity and quick response. Paper discusses limitations of prevailing instruments—volts, amperes, watts, vars, power factor—and enumerates refinements which circumvent them, along with improved methods of calibration.

**Relative Accuracy of Three-phase Metering Combinations.** By **C. T. Weller** (General Electric).

Grades various combinations of instrument transformers and watt-hour meters in scale of relative accuracy. Seventeen ruling cases analyzed, diagrammed and classified; they cover three-wire and four-wire systems with isolated, single-ground and multi-ground system connections with various combinations of two and three instrument transformers. An important reference paper to settle doubts in practice.

**The Shielding of Permanent Magnets from Transient Magnetic Fields.** By **George J. Wey** (Westinghouse).

Discusses demagnetization of watt-hour meter magnets by lightning discharges. Recommends use of magnets with new duPont high-speed copper plating. Completely interchangeable with unshielded magnets. Air gaps may be cleaned with magnetic cleaning tools without disturbing the calibration.

Relatively little difference in jewel wear due to variation in orientation of the crystal axis was found by B. W. St. Clair (Mico Instrument) in studying more than 300 jewels

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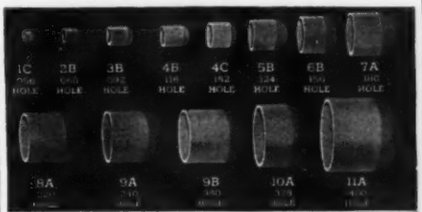
run in service in I-16 and I-17 meters for five to seven years. He felt that Goss had oversimplified the physics and doubted whether the spread of his data warranted stiffening of requirements imposed on jewel makers.

Other factors than metering accuracy were suggested by G. S. Lunge (General Electric), as affecting the number and connection of instrument transformers for polyphase metering; these were the provision of potential for directional and ground relaying, economy in single- vs. two-bushing transformers, safe operation of potential transformers, prevention of diversion and accommodation of ground fault neutralizers at a later date. Low power factor loads (*e.g.*, transformer excitation losses) may also call for choice of connections which will avoid imposing third harmonics on the meter potential coils. Also in three of the cases in the Weller paper it is possible to use the metering transformer for ground detection purposes. P. A. Borden (Bristol Company) pointed out that delta connection of current transformers has about the same degree of metering errors under abnormal conditions as does the use of a split-element meter.

## Industrial Power Applications

**A Distribution System for Wartime Plant Expansion.** By J. L. McKeever (Canadian General Electric).

Discusses decisions on design for two buildings, one 370,000 sq.ft. and 6,000 hp. plus 900 kva., the other 245,000 sq.ft. and 2,500 hp. Nine 600-kva. unit substations on a 616-kv. loop main supply 575-volt secondary network. Pyranol-filled transformers in switch inclosure at columns cheaper than oil-cooled units in below-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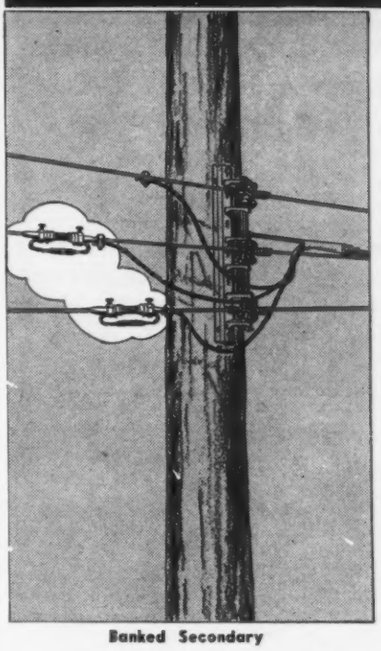

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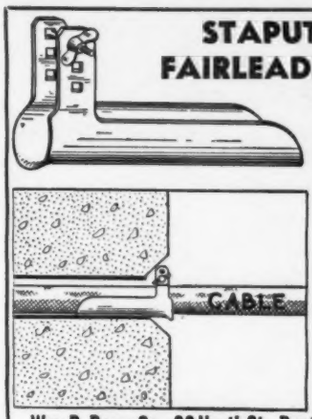


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**A New Mercury Rheostatic Element for Regulation and Control.** By K. A. Oplinger (Westinghouse).

"Mercurystat" has large number of hermetically sealed mercury contacts requiring small force and travel for operation. Power amplification on order of 100,000. Six kw. controlled in 40 steps. No wearing moving parts. Appropriate for automatic control systems for motors, exciters, etc.

**The Incandescent Lamp Situation from the Engineering Point of View.** By P. S. Millar (Electrical Testing Laboratories).

Appraises incandescent lamp at its present stage of development. Specific data and charts as to efficiency, consistency, handling losses, life, cost, research, trend to larger wattages.

The great progress of the incandescent lamp from its difficult beginning to the highly efficient and flexible illuminant of the present day, as recited in Mr. Millar's paper, has resulted, said M. L. Soan (General Electric), from unremitting attention to engineering and to standardization. Walter Wagner (Philadelphia Electric) rose to remark that the efforts of Mr. Millar himself toward standardization of lamp quality were no small contribution to lamp development.

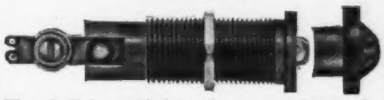
The distribution system described in the McKeever paper is not a low-voltage or secondary network system, said John S. Parsons (Westinghouse) but rather a banker secondary, since it lacks the inherent characteristics of service reliability of the network. A closer approach to the network might have been installed for the same or less money, he asserted. R. H. Kaufmann (General Electric) said that for general application it would be advisable to incorporate a more extensive primary switching system, the better to localize effects of electrical failure and to insure quicker restoration of service.

The great value of using standardized products to lower the cost of industrial distribution were clearly apparent from the paper, remarked G. R. Langley (Canadian General Electric). This feature was also pointed out by J. J. Orr (U. S. Rubber) who said that the problem of getting materials and equipments for industrial plant expansion in the present defense emergency could be greatly simplified by purchase of such standard products.


HIGH GRADE
HARD PORCELAIN
FOR
Electrical Specialties
High and Low Voltages

IMPERIAL
PORCELAIN WORKS
TRENTON, NEW JERSEY

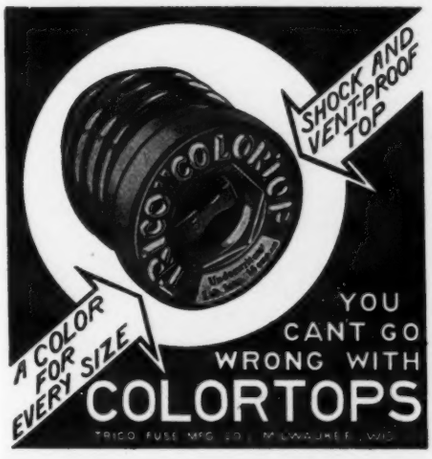
**NEW ALL-PLASTIC SWITCHBOARD LAMP**
FOR SINGLE HOLE PANEL MOUNTING
Type T2 Unit



The shell is molded in the same color as the lens-cap to prevent error in replacement . . . furnished with a 24 volt slide-base lamp, (.038 amp.) . . . used with a series resistor assembly for operation on voltages up to 440 . . . five different colors . . . brilliant 180 degree visibility . . . low in cost.

*Write for Ten Page Catalog*

**GRAYBAR ELECTRIC CO.**
H. R. KIRKLAND CO., Morristown, N. J.




**70 MASTER-LIGHTS**
**for Better, Faster Night Repairs**
High Power and Convenience to Increase the Efficiency of Your Line Crews

**Type "T"**
The most powerful automobile spotlight made. (Roof-type (Inside Pistol Grip Control). Range one-mile. Swings in complete circle, any angle, up or down. Penetrates fog or smoke. Operates from car battery. Best construction throughout. Chrome plated, polished, aluminum handle. No gears to wear or rattle. Rust and weather-proof.

• Type T, above, is but one of the 70 Master-Lights that help give your line and repair crews adequate light to speed up emergency jobs, end outages more quickly, retain customer goodwill. Types available include worklights, searchlights, floodlights, warning lights, patrol lights, watchman's light . . . and other lights for all conditions. 30-day free trial. Send for descriptive literature.

CARPENTER MFG. CO.
Master-Light Makers
167 Sidney St.
Cambridge, Mass.

**Crapo**
GALVANIZED STEEL
**STRAND**

STRENGTH, ruggedness and durability are combined with definite economy in *Crapo* Galvanized Steel Strand. Low first cost, low maintenance expense are matters of record wherever this time-tested product is in use. Available in all standard grades and sizes from representative jobbers throughout the country. Or, write—

**INDIANA STEEL & WIRE CO.**
MUNCIE, : : INDIANA

# SEARCHLIGHT SECTION

## EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

**UNDISPLAYED RATE:**

10 cents a word, minimum charge $2.00.

*(See ¶ on box Numbers.)*

*Positions Wanted* (full or part-time salaried employment only), one-half the above rates.

*Proposals*, 50 cents a line an insertion

**INFORMATION:**

*Box Numbers* in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

*Discount* of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

**DISPLAYED—RATE PER INCH:**

The advertising rate is $6.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

*An advertising inch* is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. E.W.

*NEW ADVERTISEMENTS received by 10 A. M. July 7th will appear in the July 12th issue subject to limitations of space available.*

## POSITIONS VACANT

GRADUATE ELECTRICAL ENGINEERS or experienced electrical draftsmen qualified to design electrical stations by Midwest Public Utility Engineering Organization wanted. Application should include outline of training and experience, and indicate salary desired. P-904, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

MANUFACTURER selling nationally will add to their staff an electrical engineer who has had engineering experience as well as business experience. Position is investigating the manufacturing of new products. Kindly give your experience and compensation desired. P-916, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

EXPERIENCED OPERATORS on large high pressure turbines, auxiliaries, powdered fuel boilers wanted. Location approximately 100 miles from Philadelphia, Pa. P-917, Electrical World, 330 W. 42nd St., New York, N. Y.

DRAFTSMEN: Electrical, experienced generating station and substation. Location New York City. State experience and salary desired. P 918 Electrical World, 330 W. 42nd St., New York, N. Y.

## EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 31 years' recognized standing and reputation carries on preliminary negotiations for positions of the calibre indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y.

Executives and Technical Men. Qualified candidate desiring $2,500 to $20,000 position may contact employers through our confidential services, established 26 years. The National Business Bourse, 20 W. Jackson Blvd., Chicago.

## POSITIONS WANTED

*(See also "Selling Opportunities Wanted")*

ELECTRICAL ENGINEER—15 years progressing experience. Watt hour meters relays voltage regulators—automatic equipment, breakers, synchronous condensers, sub-stations; load-voltage problems. Desires connection with utility or manufacturer. PW-903, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

ELECTRICAL ENGINEER, professional license, 20 years experience supervising electrical layouts and designs for industrial power plants and distribution systems, also experienced in steam plant design. Available now, prefer locate vicinity New York City. W. F. Demmerle, 84 Bay Driveway, Manhasset, N. Y.

ACCOUNTANT-EXECUTIVE—Six years college, ten years experience with utility holding and operating companies in auditing, cost, securities, taxes, corporate matters, systems and methods, seeks position as office manager or assistant to major executive. Free to travel. Reply, PW-910, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

**ENGINEER AVAILABLE**

Graduate mechanical and electrical engineer. Training and experience with G.E., Westinghouse, Commonwealth Edison, South American Steamship Line and a Brazilian Public Utility as superintendent of power house in charge of all electric construction and operation of the largest hydro electric plant in Brazil.

**PW-925**, Electrical World
520 No. Michigan Ave., Chicago, Ill.

## POSITIONS WANTED

ELECTRICAL ENGINEER, Member AIEE, 20 years experience supervision electrical design, construction and operation in power plants, transmission lines, substations and distribution systems with Public Utilities and Consulting Engineers. Desire to make change to position of some responsibility and permanence. PW-919, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

ELECTRICAL ENGINEER and EXECUTIVE 38. Diversified and balanced experience all phases utility operations, design, construction and operation, power plants, transmission, distribution, industrial service, rates, budgets, public relations. Excellent record employee relations, civic affairs, organization and supervision. Fully capable as executive assistant or superintendent, position with consulting or management firm, or with financial institution. Now employed. PW 920, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

LOOK—Ambitious, energetic man age 37 desires permanent position electrical engineering field. Six years experience foreman on construction including underground, overhead, substation, also control installation and building construction. Two years college training, good mathematician. With present employer nine years. Will continue studies along lines necessary for success and advancement. PW 921, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

**SELLING OPPORTUNITIES**

OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

## OPPORTUNITIES WANTED

SALESMAN covering manufacturers and jobbers Massachusetts, Connecticut and Rhode Island desires additional line either materials or specialty. Address SA 922, Electrical World, 330 W. 42nd St., New York, N. Y.

A LONG ESTABLISHED and highly organized manufacturer's Sales Representative in Pittsburgh, Pennsylvania can efficiently sell one or two additional lines of high quality electrical material of national acceptance produced by a manufacturer who sells exclusively through the wholesaler. Strictest investigation is invited as to knowledge of the Industry, established distribution, and financial responsibility. RA 923, Electrical World, 330 W. 42nd St., New York, N. Y.

## OFFICIAL PROPOSALS

Bids: July 10 (77)

### *Lightning Arresters and Circuit Breakers*

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

SANTEE-COOPER PROJECT
DOCKET NO. 4329-P-R

115 KV LIGHTNING ARRESTERS AND OIL CIRCUIT BREAKER

1. TIME AND PLACE OF OPENING BIDS: Sealed proposals for furnishing four sets of lightning arresters and one oil circuit breaker will be received by the South Carolina Public Service Authority at the office of the Engineer, Harza Engineering Company, 27 Cumberland Street, Charleston, S. C., until 10:00 a. m., July 10, 1941, at which time all proposals will be publicly opened and read.

**COMPLETE PLANT FOR SALE**

5500 KW in two units. AC. Condensing
10—400 HP. B&W. Boilers, 200#. ASME.
***Also Extraction Turbo units***
1—1000 KW., 1—500 KW., 1—300 KW.

**STEPHEN A. DOUGLASS CO.**
630 Fort Washington Ave., New York, N. Y.

## OFFICIAL PROPOSALS

2. PROCUREMENT OF PLANS AND SPECIFICATIONS: Proposals must be submitted on the forms furnished by the Authority. These forms, including the plans and specifications and other contract documents, may be obtained from the office of the Secretary of the Authority, Room 508, Peoples Office Building, Charleston, S. C., upon payment of $10.00 for the first set and $3.00 per set thereafter. No refund will be made. These documents may also be examined free of charge at the offices of the Authority, Columbia and Charleston, S. C.; at the offices of the Engineer, 27 Cumberland Street, Charleston, S. C., and 205 W. Wacker Drive, Chicago, Illinois; at the offices of the Associated General Contractors, Charlotte, N. C., Atlanta, Ga.; and at the plan room of the F. W. Dodge Company, Atlanta, Ga.

3. DESCRIPTION OF THE WORK: Separate and combined bids will be received on the work as follows:

Schedule 1—115 kv. Lightning Arresters: This schedule will consist of furnishing four sets of three phase, 115 kv. lightning arresters with braces for the Pinopolis Main Switchyard about 32 miles north of Charleston, S. C.

Schedule 2—115 kv. Oil Circuit Breaker: This schedule will consist of furnishing one 115 kv., 1,000,000 kva rupturing capacity, standard duty oil circuit breaker for the Charleston Substation near North Charleston, S. C.

4. BIDDER'S BOND: Each bid must be accompanied by a certified check or bidder's bond executed by the bidder and a surety company licensed to do business in South Carolina and Countersigned for the Surety by an agent or attorney-in-fact who is a bona fide resident of the State of South Carolina, in the sum of not less than five percent of the amount of the bid. This is required as a guarantee that if the bid is accepted, a contract will be immediately entered into and the performance of it properly secured. The certified check or bond will be returned upon non-acceptance of bid or execution of contract.

5. WITHDRAWAL AND REJECTION OF BIDS: No bid may be withdrawn for a period of thirty days after the date set for the opening of said bid. The Authority reserves the right to reject any or all bids and to waive informalities therein.

6. LICENSES: Bidders not fabricating any shop work in South Carolina are not required to secure General Contractor's Licenses.

The General Counsel of the South Carolina Tax Commission has ruled that manufacture outside the State and shipping equipment to the site of the project is not subject to Bidders' or Contractors' License Taxes under Section 2543 of the Civil Code of 1932.

Any Bidder not exempted under the above paragraphs will be required to show issuance of such licenses before his bid is opened or considered.

By order of the Board of Directors.

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY.

By Tom B. Pearce,
Chairman.

*(Reproduced from publication dated 1893)*

*"STRIP" the electrician. The clever fox terrier belonging to Messrs. Crompton, the electric engineer preparing to go to work underground. Strip's business is to carry each electric light wire through the pipe to the workmen waiting at the other end, who disengage it from her collar to which the wire is fastened before she starts. The dog scrambles through the pipe with the utmost vigor and seems to understand perfectly what her business is, and does it without any delay. Before going to Brighton, Strip did good work for her employers in London, where she laid down many miles of electric light wire.*

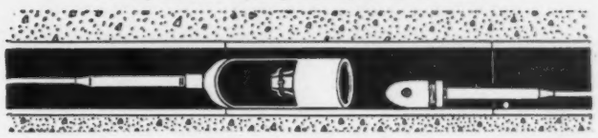
# But DOGS won't do for You!

MOST old style Duct-Rodding equipments are as out of date as the use of dogs. But with new Electroline Duct-Rodding equipment the job that formerly took two gangs two weeks can now be done in thirty minutes with one gang and at a fraction of the labor costs.

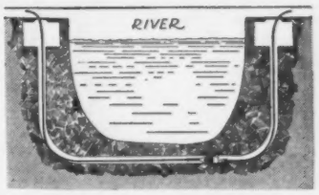
Its rapid adoption by utilities in every corner of the country has proven that it can do the hardest job easily and the easiest job at a lower cost. The first cost of the equipment is surprisingly low. Its construction is simple and trouble-free and it is so durable that it will last for years and years with the hardest kind of use.

Investigate the time and cost reduction that can be made on your own work. Get full details and prices. Send now for a copy of descriptive Bulletin No. DR-2 251.

*Pick-up and Leader fittings meeting, as shown below.*



*Right, Electroline Steel Rodding Equipment feeds easily around the bends.*




*Below, Leader locked in Pick-up for either push or pull.*

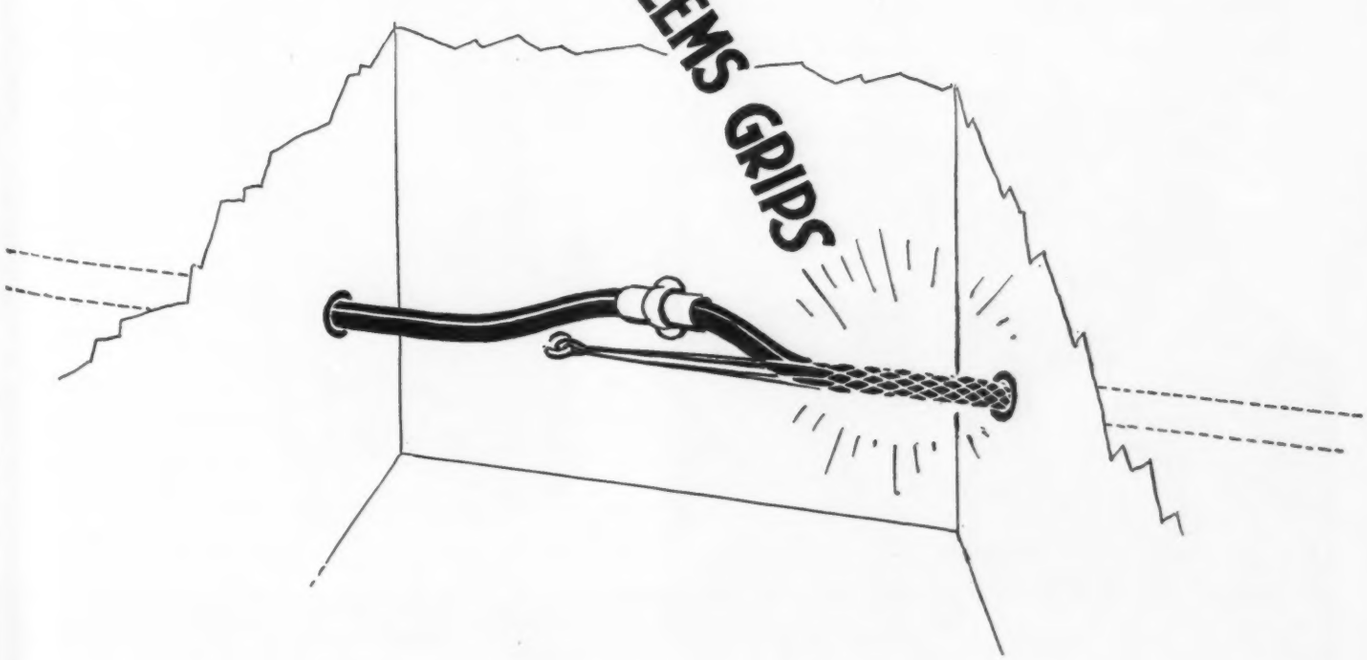
PATENT APPLIED FOR

**Electroline Company**

4121 SOUTH LA SALLE STREET
CHICAGO, ILLINOIS

OIL-FILLED CABLE
slipping
?

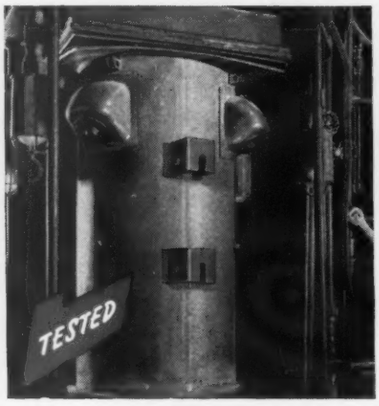
# Anchor! WITH KELLEMS GRIPS



*Important information*— KELLEMS COMPANY...1911 PARK AVE..NEW YORK CITY

# REASONS WHY ENGINEERS CHOOSE THE NEW

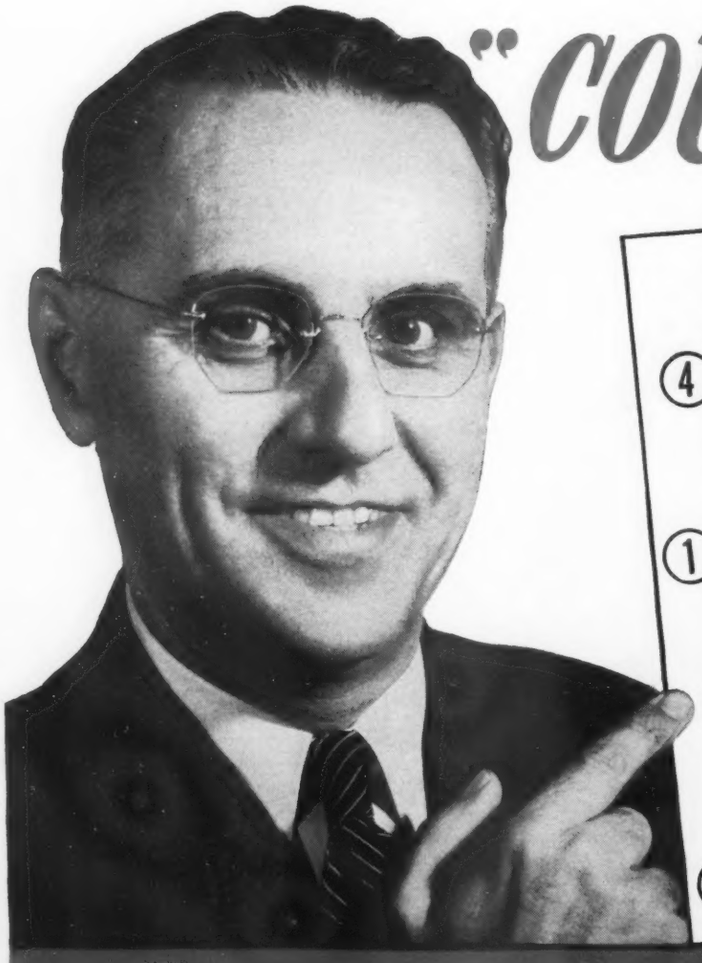
**1** Simplified Supports for Direct Pole Mounting Cut Installation Time. Standard Support Spacing and Bushing Location Mean Complete Interchangeability of All Sizes and Makes.

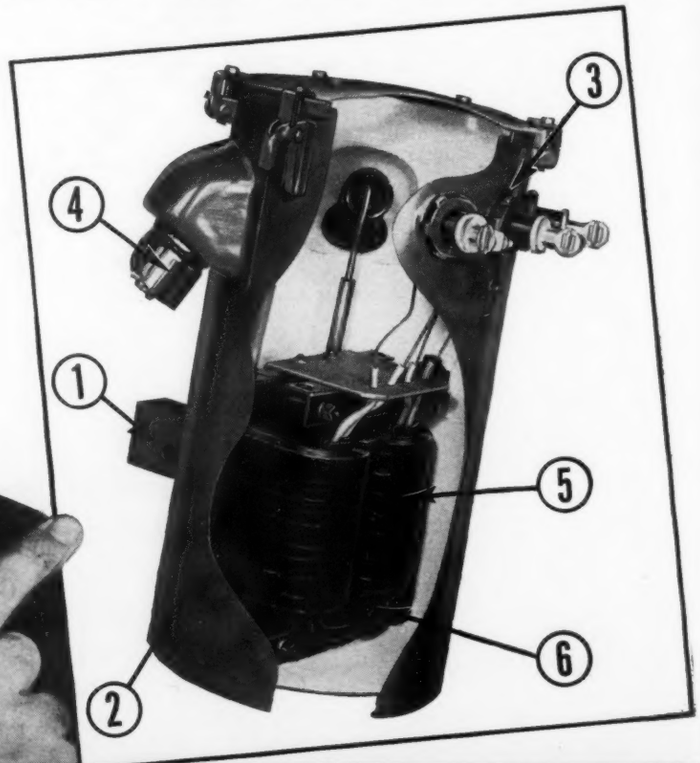



**2** New, Durable, Copper-Bearing Steel Tanks. Tested Under Pressures Far Greater than Normal . . . Prevent Oil Leakage, Assure Long Life and Complete Safety.

**3** New Spra-bonderizing Process . . . Plus Triple Coat Automobile Finish Give Tanks Positive Four-way Protection Against Attacks of Rust and Corrosion.

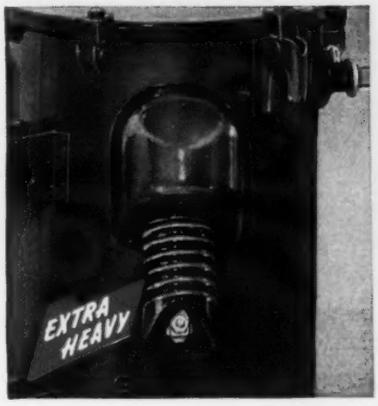
# "COULDN'T BE





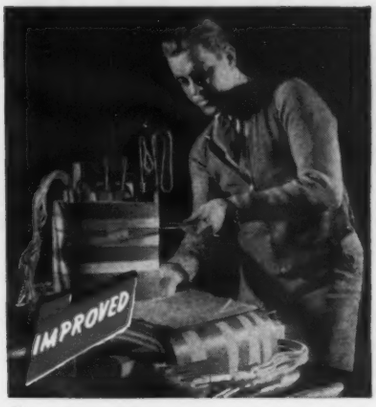

## ALLIS-CHALMERS DISTRIBUTION

# ALLIS-CHALMERS DISTRIBUTION TRANSFORMER




**4** Extra-heavy Porcelain Coordinated Bushings with Liberal Creepage Offer Maximum Reliability Under Fog, Dust, Chemical or Other Adverse Conditions.

**5** Double Conductor Insulation... Flexible Enameled Wire... Plus the Added Protection of Well-Lapped Cable Paper Provide Double Safety Against Winding Failures.




**6** Improved Core and Coils, Liberally Designed with No Manufacturing Short Cuts . . . Mean Extra Years of Service-free Performance Under All Types of Operating Demands.

# *BETTER If I Designed It Myself!"*

And why not?

That's exactly what you did — for you and other utility engineers all over the country actually "wrote the specifications" for the new Allis-Chalmers Distribution Transformer.

"Your" transformer makes specifying and buying easier . . . permits faster deliveries and easier installation . . . reduces the number of complete units and parts to be carried in stock.

This simplification will undoubtedly save thousands of dollars, not only in first cost, but in operating expenses as well. And it's made possible by standardizing the locations of supports and bushings — all sizes and makes are now completely interchangeable.

But we didn't stop there! Into the manufacture of this new transformer we put all the benefits of advanced engineering . . . plus the best material and skilled workmanship . . . to give you built-in quality that's second to none!

Check the six big engineering features of the new Allis-Chalmers EEI-NEMA Distribution Transformer shown here. Then call the Allis-Chalmers district office near you. Or write direct to Allis-Chalmers, Milwaukee, for your copy of Bulletin B-6159.

A-1412

**TRANSFORMERS** *Cut Operating Costs*

# YOU SET IT AND FORGET IT

## The Exide Charge Control Unit signals when the charge is complete

NOTHING could be simpler, or take less of a maintenance man's time, than maintaining an Exide-Ironclad Battery.

About once in two weeks it needs flushing, ordinarily. It pays to wipe down the battery occasionally, or blow it off with an air hose, just to keep it tidy. Charging is equally simple and easy with the Exide Charge Control Unit.

This device charges an Exide-Ironclad at exactly the right rate. When the charge is complete, it shuts off the current. Then it flashes a signal light to show that the battery is ready for service.

Write for free booklet, "The Exide System for Better Material Handling."

**Exide**
**IRONCLAD**
**BATTERIES**

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
*The World's Largest Manufacturers of Storage Batteries for Every Purpose*
Exide Batteries of Canada, Limited, Toronto

"Cope"

*If you know this name you know "Quality"*

**CABLE FEEDER** — Facilitates pulling-in of cable. Does not permit damage to the sheath.

**CABLE BENDER**—For the bigger jobs. The adjustable yoke and smooth shoes make bending easy without harm to the cable.

**MANHOLE GUARD RAIL (TYPE 264)** — Neatness and strength made possible by sleeves and hinges of seamless steel tubing and completely welded construction. The wing bow brace across the back holds the sides firmly in position.

**SAFETY COMPOUND KETTLE** — Large, 3 gallon capacity Safe and Efficient.

**CABLE PULLING RIGGING**— Provides a direct pull through the manhole. Will accommodate up to 3½" cable.

● **CABLE RACKS AND ARMS (TYPE T)**—The uprights are of 1½" channel. The arms have double struts that bear against the flanges instead of the thin web. They are interchangeable with other similar racks.

*"One picture is worth a thousand words" we suggest. "One trial is better than a thousand adjectives"*

Here are shown just a few of the many efficient labor saving tools manufactured by T. J. COPE, Inc. We've been making this kind of equipment for over 50 years. Because we've been at it so long we know what cable men **want** and **why.**

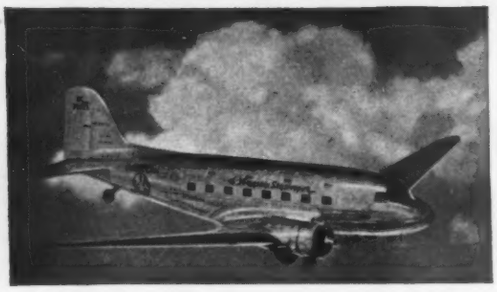
Don't miss a good bet. Ask us for any information you may desire.

**T. J. COPE, Inc.**

**6120-22 VINE STREET PHILADELPHIA, PA.**

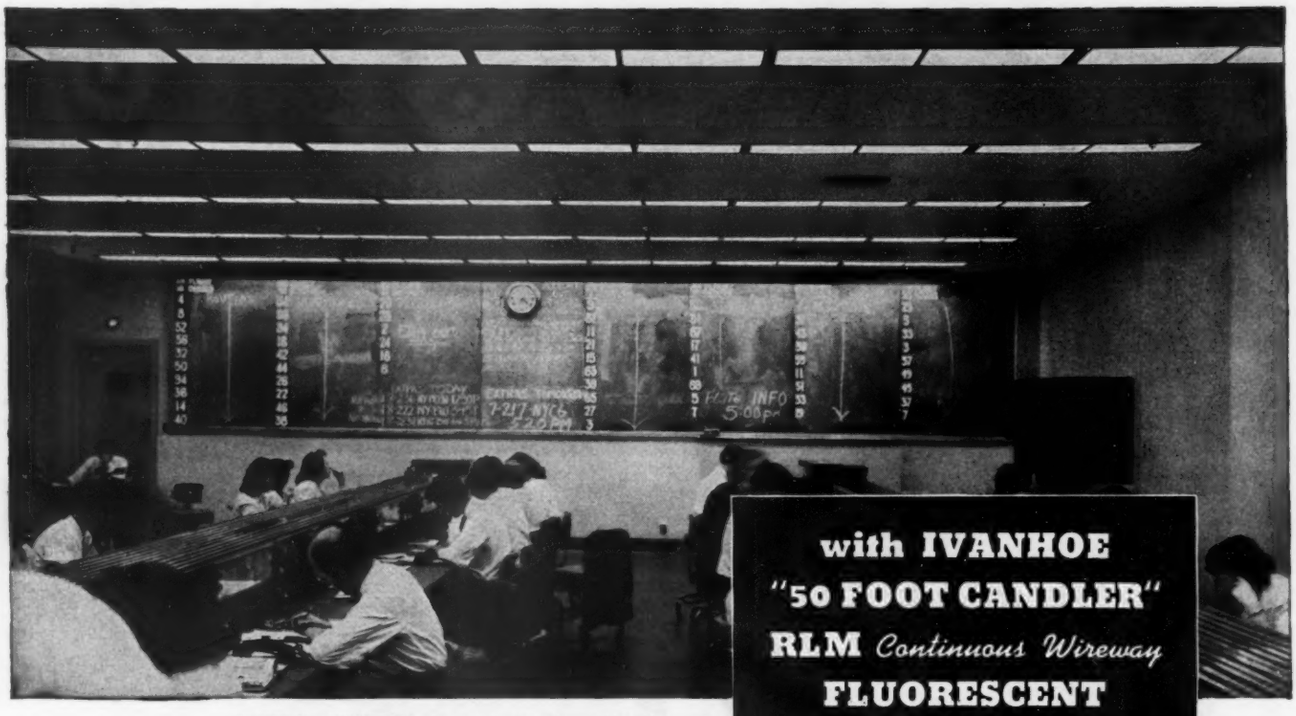
WRITE FOR OUR CATALOG AND PRICE LIST TODAY

CONDUIT RODS • ROD PULLERS • ROD ADAPTERS • REEL JACKS • PULLING RIGGINGS • CABLE FEEDERS • DRAWING-IN PROTECTORS • COMPOUND KETTLES • CABLE BENDERS • CABLE RACKS • PULLING EYES • PULLING SWIVELS • MANHOLE GUARDS • MANHOLE LADDERS • MANHOLE STEPS • PULL-IN IRONS • COVER HOOKS • DUCT SHIELDS • BOND PLATES • BONDING WIRE • CONDUIT TOOLS • CONDUIT CLEANERS • CONDUIT BRUSHES • CONDUIT MANDRELS • CABLE HANGERS • AERIAL FEEDERS • SLACK PULLERS



# AMERICAN AIR LINES

## GET BETTER LIGHT *Fast-Economically* TO SPEED VITAL OPERATIONS



**with IVANHOE "50 FOOT CANDLER" RLM *Continuous Wireway* FLUORESCENT LIGHTING SYSTEM**

*"NERVE CENTER" of great American Air Lines at LaGuardia Field, N.Y. is this busy Reservation Room. For maximum worker efficiency it is lighted with IVANHOE "50 FOOT CANDLER" recessed in the ceiling, providing fine, well-diffused fluorescent lighting.*

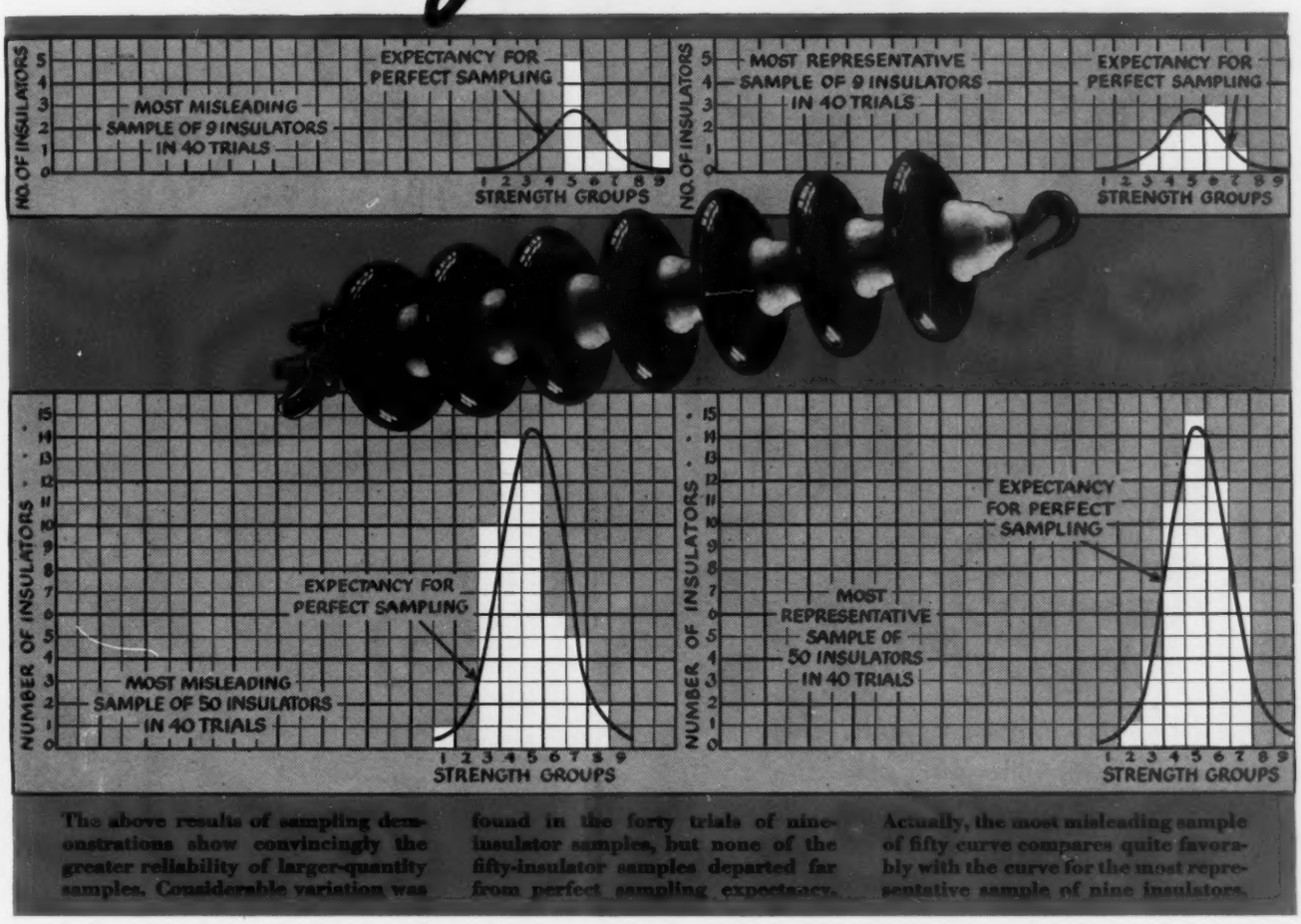
**TODAY WITH DEFENSE IN THE DRIVER'S SEAT, THIS BETTER FLUORESCENT LIGHTING SYSTEM CAN HELP YOUR CUSTOMERS—BUILD LOAD FOR YOU**

● IVANHOE "50 FOOT CANDLER" went to work for American Air Lines quickly and economically. It can do as much for your customers. This better *lighting system* is engineered that way. Its built-in wireway contains up to 80 per cent of necessary building wiring. Cuts installation costs from 30 to 50 per cent. Permits people to go right on working while system's going in. Maintenance? A cinch—with conveniently removable reflectors.

When the lighting user not only gets higher illumination and simplified maintenance but starts his investment with a substantial installation saving—you have the ideal combination for selective load building. We developed IVANHOE "50 FOOT CANDLER" *(the first RLM Continuous Wireway Fluorescent Lighting System)* with these important things in mind. Write for details in Bulletin 1C.

**THE MILLER COMPANY**
MERIDEN, CONN.
*Pioneers in Good Lighting Since 1844*

# HOW SCIENTIFIC SAMPLING *Benefits Insulator Users*


NO. OF INSULATORS
MOST MISLEADING SAMPLE OF 9 INSULATORS IN 40 TRIALS
EXPECTANCY FOR PERFECT SAMPLING
STRENGTH GROUPS
MOST REPRESENTATIVE SAMPLE OF 9 INSULATORS IN 40 TRIALS
EXPECTANCY FOR PERFECT SAMPLING
STRENGTH GROUPS
NUMBER OF INSULATORS
MOST MISLEADING SAMPLE OF 50 INSULATORS IN 40 TRIALS
EXPECTANCY FOR PERFECT SAMPLING
STRENGTH GROUPS
NUMBER OF INSULATORS
MOST REPRESENTATIVE SAMPLE OF 50 INSULATORS IN 40 TRIALS
EXPECTANCY FOR PERFECT SAMPLING
STRENGTH GROUPS

The above results of sampling demonstrations show convincingly the greater reliability of larger-quantity samples. Considerable variation was found in the forty trials of nine-insulator samples, but none of the fifty-insulator samples departed far from perfect sampling expectancy. Actually, the most misleading sample of fifty curve compares quite favorably with the curve for the most representative sample of nine insulators.

● Because the strength of a suspension insulator string is determined by the weakest unit, minimum strength values are essential for the proper selection of insulators. By applying a scientific sampling system, O-B determined that the M & E ratings of its insulators are their minimum strengths, and thus users were provided with the dependable values they need. Aside from this benefit, the new sampling method enables O-B to secure reliable probability curves which permit accurate control of both quality and uniformity during manufacture.

Using recognized actuarial methods in the application of the sampling system, O-B found that a thousand specimens have to be tested to obtain dependable strength data. Plotting the strength values of a thousand insulators gives a probability curve which, with an approved statistical method, enables correction factors to be figured for small-quantity samples. The importance of developing accurate curves from an adequate number of tests is demonstrated in the above charts which show the possible errors to be expected from small-quantity samples and the greater reliability of larger ones.

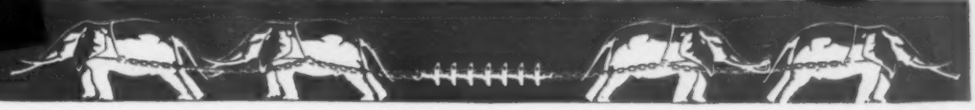
To secure better insulators—having minimum strengths you know are dependable because of scientific sampling—buy your suspensions from O-B.

*Buy the Best ...Buy O-B*

**Ohio Brass** (B)

MANSFIELD, OHIO, U. S. A.

*Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont.*



# BURNDY LUGS

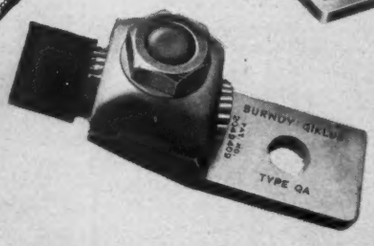
## WITH TIME MORE VITAL THAN EVER USE CONNECTORS THAT SAVE TIME

Time is mighty important, in these days of rapidly expanding production. That's why you need Burndy Lugs. They're designed to save precious time—do a neat, clean job in several minutes, with only a wrench or a pair of pliers.

Burndy Lugs will save you time — *and money*—in maintenance care, too. That's because they give secure, permanent contact . . . withstand high pull-out stresses . . . won't corrode or overheat.

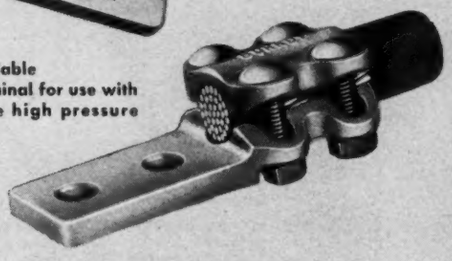
You'll find saving time easy and economical, the Burndy way. So stock up on Burndy Lugs, and start to SAVE TIME!

**SCRULUG—Type KPA**
For low cost meter connections. Compactly constructed, and easily installed with a screw driver or socket wrench.

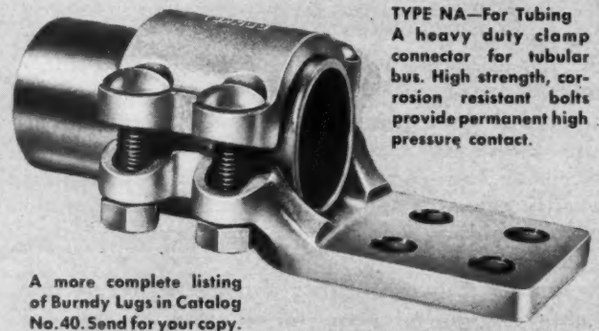



**QIKLUG—Type QA**
Available forged or cast for easy, rapid termination of wires and cables. Small dimensions, high strength.

**TYPE NA—For Cable**
A Multigrip terminal for use with cable. Multiple high pressure fingers minimize contact resistance



**TYPE NA—For Tubing**
A heavy duty clamp connector for tubular bus. High strength, corrosion resistant bolts provide permanent high pressure contact.



A more complete listing of Burndy Lugs in Catalog No. 40. Send for your copy.

# BURNDY CONNECTORS

*Our business is to help hook-up your business*

BURNDY ENGINEERING CO., INC. • 459 E. 133rd STREET • NEW YORK CITY

# *High side or low...it's PINCO for SERVICE*

PINCO CAT. No. 2215

"*Right on the Job*" are these Pinco Insulators, standard units installed on the 22 KV low side of this West Penn Power Co. substation. Mechanically and electrically, Pinco Insulators are right, from the porcelain to the exact machine alignment that guarantees precise interchangeability of similar units.

Years of service under the most rigorous conditions prove their reliability and efficiency. And to the construction engineer the name of Pinco means even more. It means delivery service that's designed to meet his construction schedule. Ask your nearest Pinco representative about Pinco Insulators and Pinco service.

**The Porcelain Insulator Corporation, Lima, N. Y.**

SALES AGENTS—The Joslyn Company—New York, Rochester, Philadelphia, Baltimore, Lynchburg; Joslyn Manufacturing & Supply Co.—Chicago, Springfield, Ill., Kokomo, Ind., Kansas City, Omaha, Oklahoma City; Jobbers Supply Co.—St. Paul, Portland, Seattle; Southeast Joslyn Company—Cincinnati, Cleveland, Westerville, O., Lexington, Ky., Atlanta, Jacksonville; J. J. Costello—Boston; Joslyn Co. of California—Los Angeles, San Francisco, Phoenix, Ariz.; H. E. Burns Co.—Pittsburgh; Southern Joslyn Co.—New Orleans; Paul Douden—Denver; Paul Carson—Amarillo, Texas; Joslyn Southwest Co.—Dallas, Houston.

PINCO INSULATORS

**RIGHT *on the job***

# 1 + 2 + 3

## *Symmetrical* DESIGN

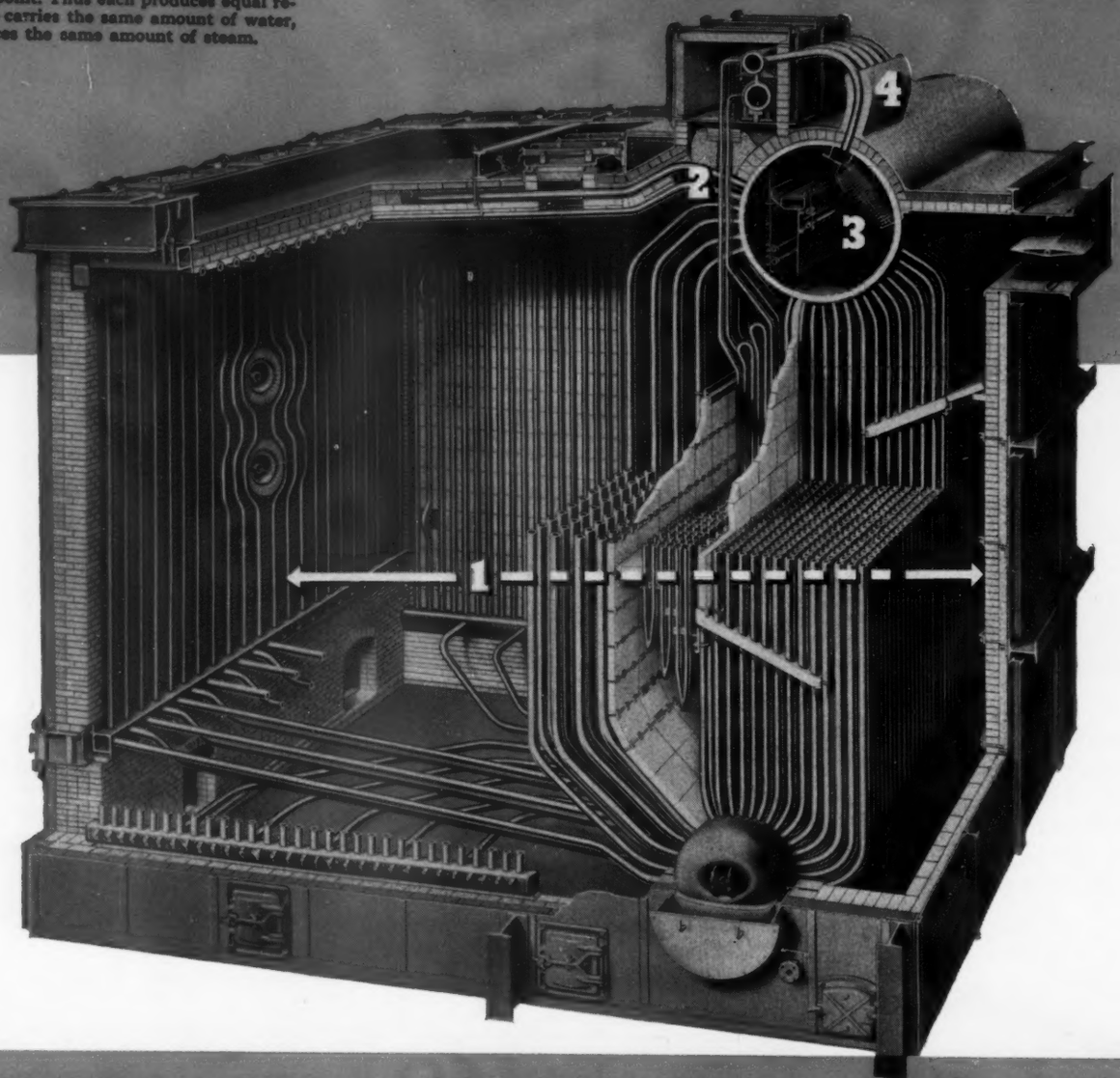
Any longitudinal section taken through the Type VU Generator is the same as any other so taken. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each produces equal results — carries the same amount of water, produces the same amount of steam.

## *Discharge Above* WATER LINE

All tubes comprising the most active steam producing surface enter the steam drum *above the normal water* level; are uniformly distributed across the length of the drum. Turbulence is minimized — steam space is fully and effectively utilized — water level is steady even with fluctuating loads.

## *Liberal* DRUM VOLUME

A steam drum of liberal diameter is characteristic of VU design. This assures adequate steam space and low steam velocity, thus minimizing the tendency to pick up impurities and permitting maximum opportunity for moisture separation.




C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

# COMBUSTION

+4

*Uniform*

**STEAM DISCHARGE**

Steam Circulators to superheater headers are short, ample in number and are evenly distributed across the drum. Steam leaves the drum promptly, uniformly and at low velocity; enters the superheater likewise. Carry-over of moisture and impurities is effectively inhibited.

# THEY ALL ADD UP TO *Clean Steam*

produced by

## COMBUSTION ENGINEERING'S VU Steam Generator

As plain as simple arithmetic is the result of these four exclusive features which distinguish the VU Steam Generator. The fact that the steam-water mixture is subjected to uniform gas temperatures across the width of the unit and enters an ample steam space above the water line creates a stabilized condition in the drum free from the surging and spouting which make the process of separating moisture-borne impurities from steam so difficult.

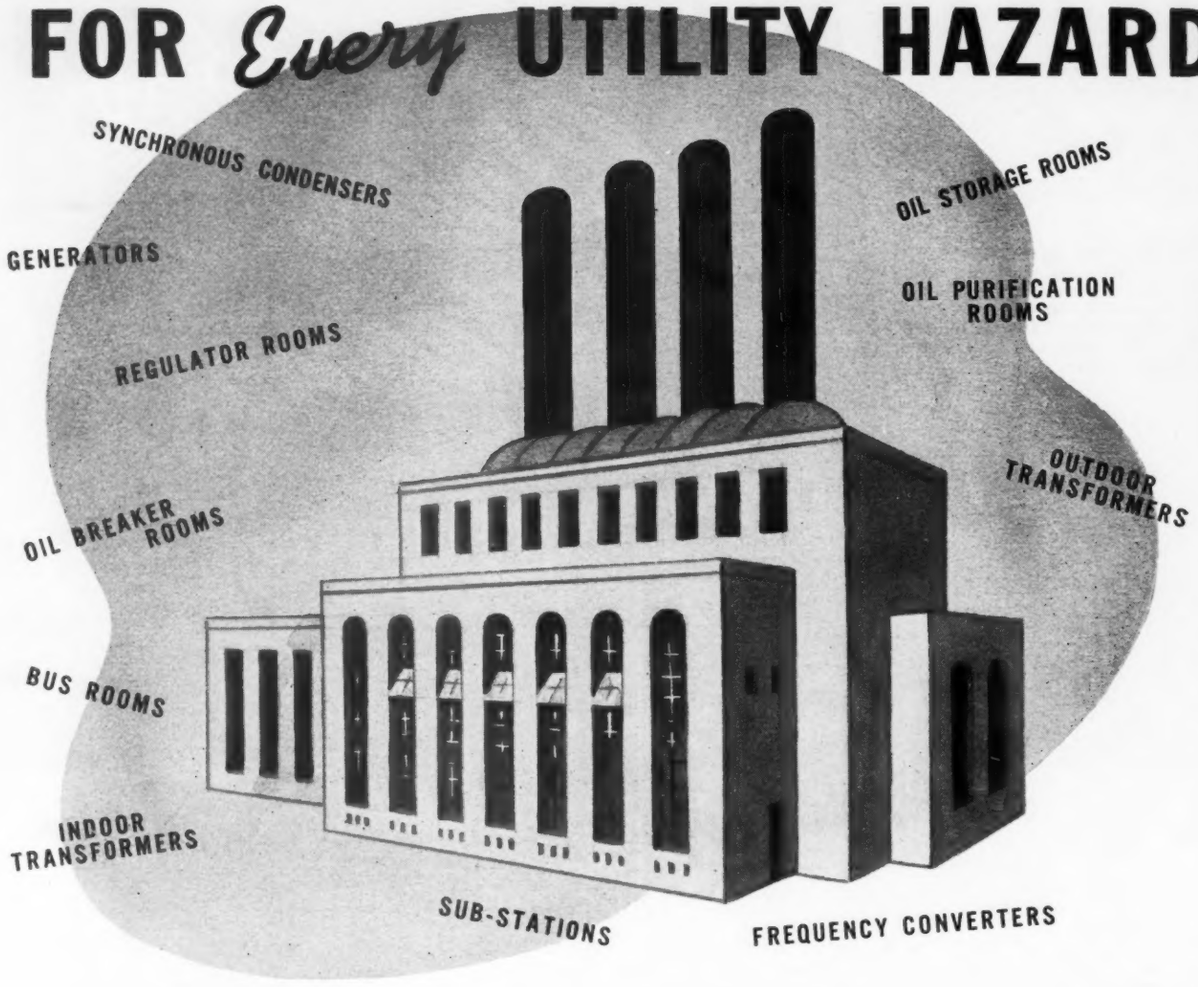
Added together these features provide maximum assurance of clean, dry steam, always important in boiler design and under today's severe operating conditions more important than ever. These features have been thoroughly demonstrated in service by a variety of installations that are meeting requirements from 30,000 to 300,000 lb of steam per hr.

When the advantages of clean dry steam are enhanced by *economical generation,* which is aided by other features of design and construction, you have the reasons for the high percentage of current repeat orders. Received from people who *know* how well the VU Steam Generator performs, they are significant evidence for any plant considering new steam generating facilities. A-599

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

# ENGINEERING

# UTMOST FIRE PROTECTION FOR *Every* UTILITY HAZARD




## *with* CARDOX THE NON-DAMAGING FIRE EXTINGUISHING SYSTEM

● The same sensational fire extinguishing properties that permit Cardox to overwhelm vicious outdoor oil transformer fires in a matter of seconds, indicate its use at every utility-hazard . . . wherever fire is a constant threat to production or transmission of vital power. Cardox is identified as the modern carbon dioxide method of *mass flow* and *mass discharge at extremely low temperatures.*

In consequence, this system not only overwhelms large as well as small fires incredibly fast, and without extinguisher damage—in addition, it affords the tremendous additional cooling effect of $CO_2$ released at sub-zero temperatures—two to three times that of $CO_2$ at atmospheric temperatures. In the particular case of utility hazards, this is of prime significance. Not only is damage held to that actually caused by fire, but high-temperature damage to costly equipment adjacent to the fire is greatly minimized.

A Cardox installation designed to reach all utility fire hazards is today's way of assuring swift, safe extinguishment with minimum damage and minimum interruption to service.

## Exclusive Advantages of Cardox Fully Told in CARDOX DATA FILE

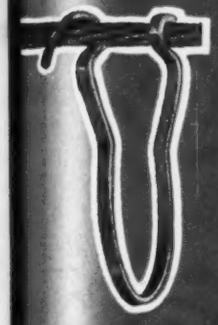
**Contains Reports, Test and Demonstration Data, Illustrations of Equipment.**

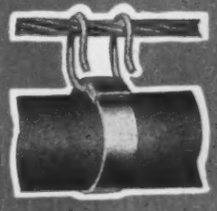
**SEND FOR YOUR COPY TODAY!**

## CARDOX CORPORATION
## BELL BUILDING · CHICAGO, ILL.

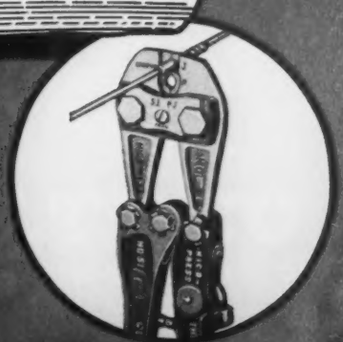
# Fortieth Anniversary

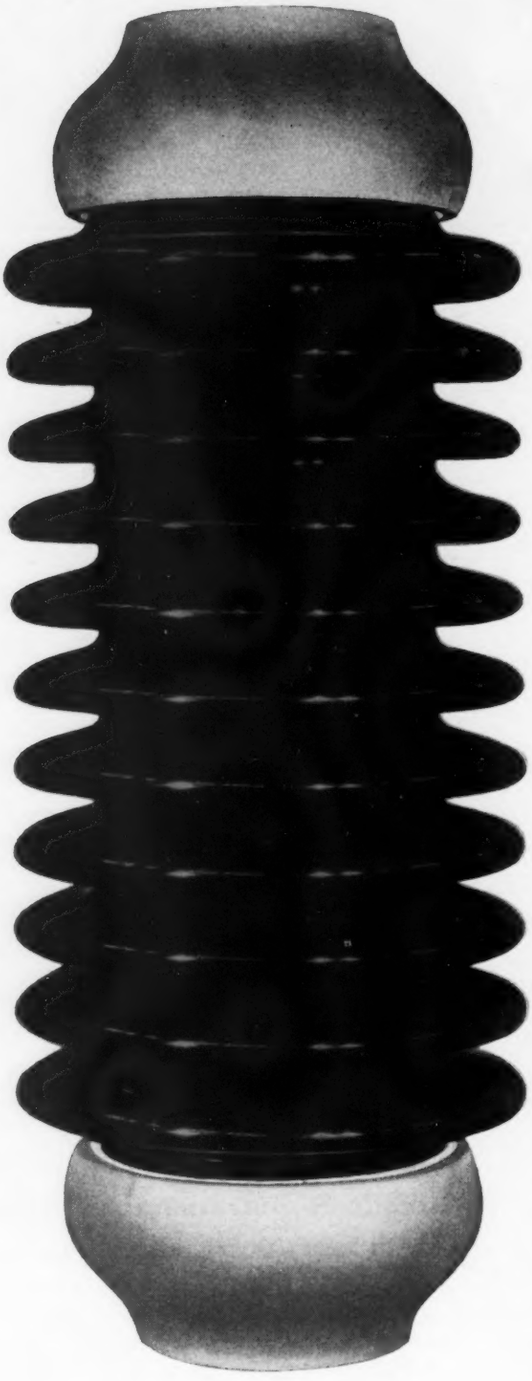
SINCE 1901 The National Telephone Supply Company has been manufacturing and selling pole line specialties to the Telephone, Telegraph, Light and Power, and Railroad Companies. ◆ ◆ During this period we, here at National, have made many highly treasured personal friendships. ◆ ◆ On this, our fortieth anniversary, we wish to express our thanks for the splendid volume of business that has been given us, and our sincere appreciation for the co-operation extended at all times. ◆ ◆ "National" products are and always have been designed to simplify and make more efficient the splicing and dead-ending of communication and power lines and to facilitate hanging cable. ◆ ◆ "National" knows that for a continuance of that invaluable asset, "customer-good-will," it must constantly endeavor, by creation and design, to improve both the quality and the efficiency of its products. It is to the continuance of this endeavor that we pledge ourselves on this, our fortieth anniversary.



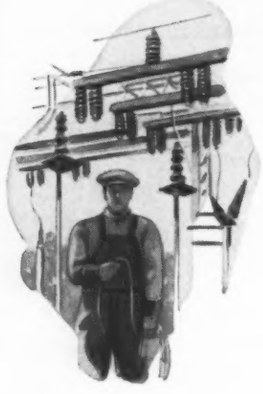


THE NATIONAL
1901 1941
TELEPHONE SUPPLY CO.
CLEVELAND





You write the ticket on what you want in switch-and-bus-insulator performance. We'll lay the odds that the Lapp Station Post comes closer to meeting your requirements than any other insulator you can buy.



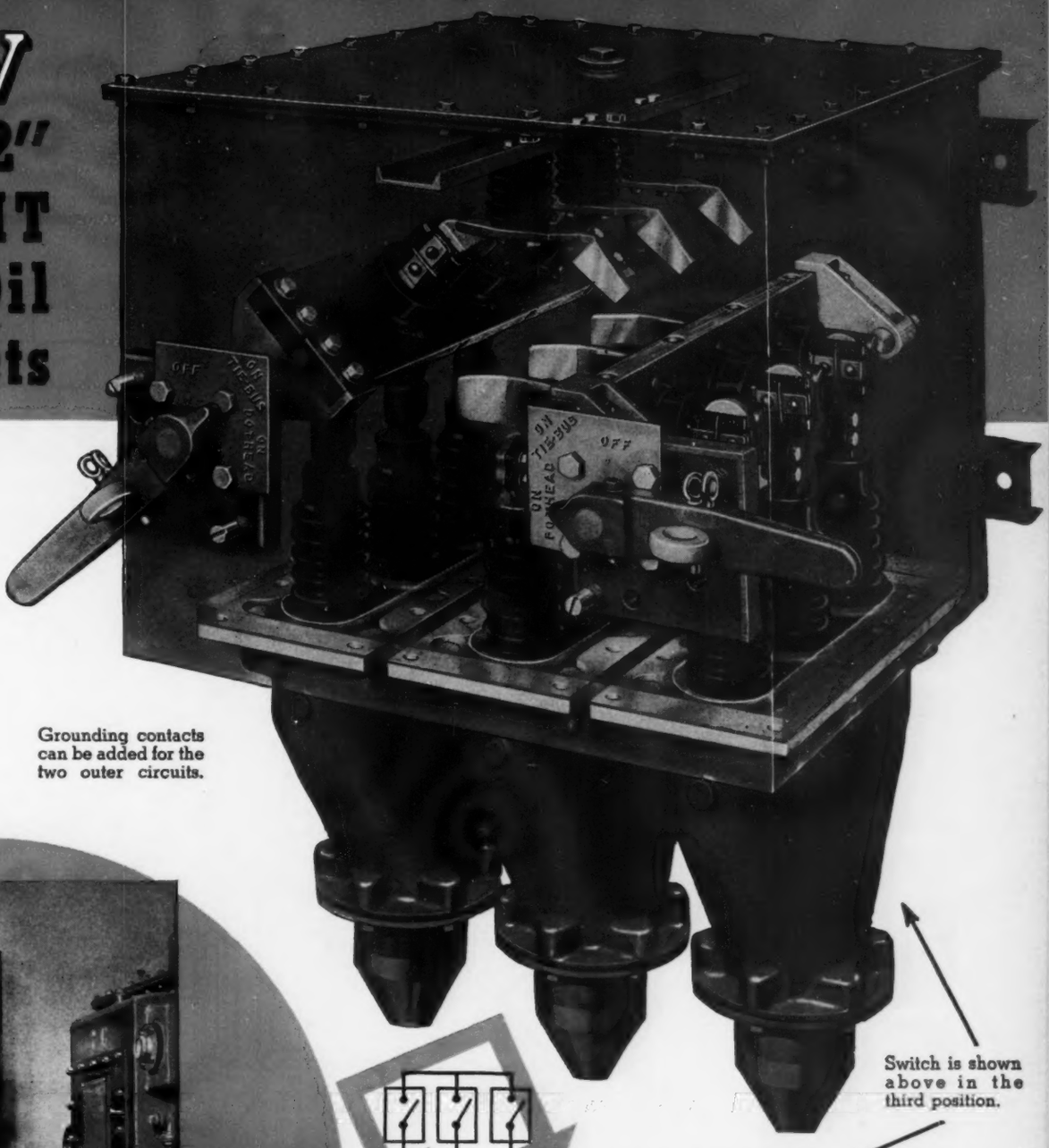
# Lapp

LAPP INSULATOR COMPANY, INCORPORATED • LE ROY, N. Y.

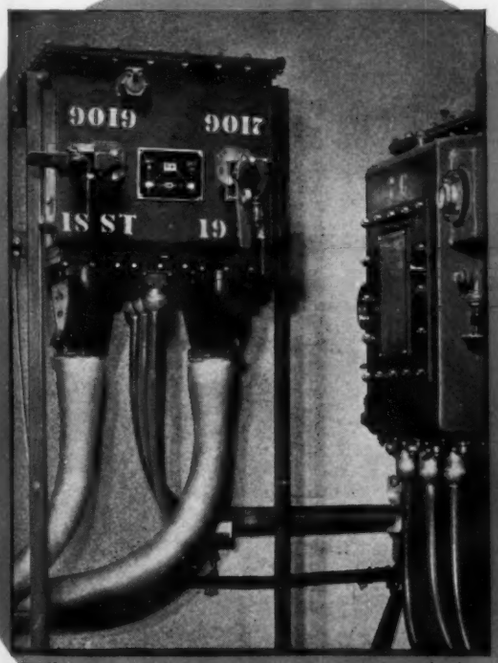
# THREE SWITCHES FOR THE PRICE OF ONE!

# G & W Type "RA-2" 3 CIRCUIT Subway Oil Disconnects

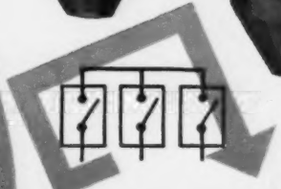
The G & W Type "RA-2" takes the place of three separate oil switches. The greater expense not only of the switches themselves but also of the larger manhole or vault space is thus saved by the one unit.




Grounding contacts can be added for the two outer circuits.




With the G & W Type "RA-2" unit, transformers can be fed from either or both of two supply circuits or tapped off a loop circuit.



Switch is shown above in the third position.

FOUR CONNECTIONS WITH ONLY TWO SETS OF LINKS

1. Loop or feed through with branch circuit connected.
2. Feed branch from left with other feed disconnected.
3. Feed branch from right with other feed disconnected.
4. Loop or feed through with branch circuit disconnected.

See also G & W Bul. 364.

G&W ELECTRIC CABLE DEVICES

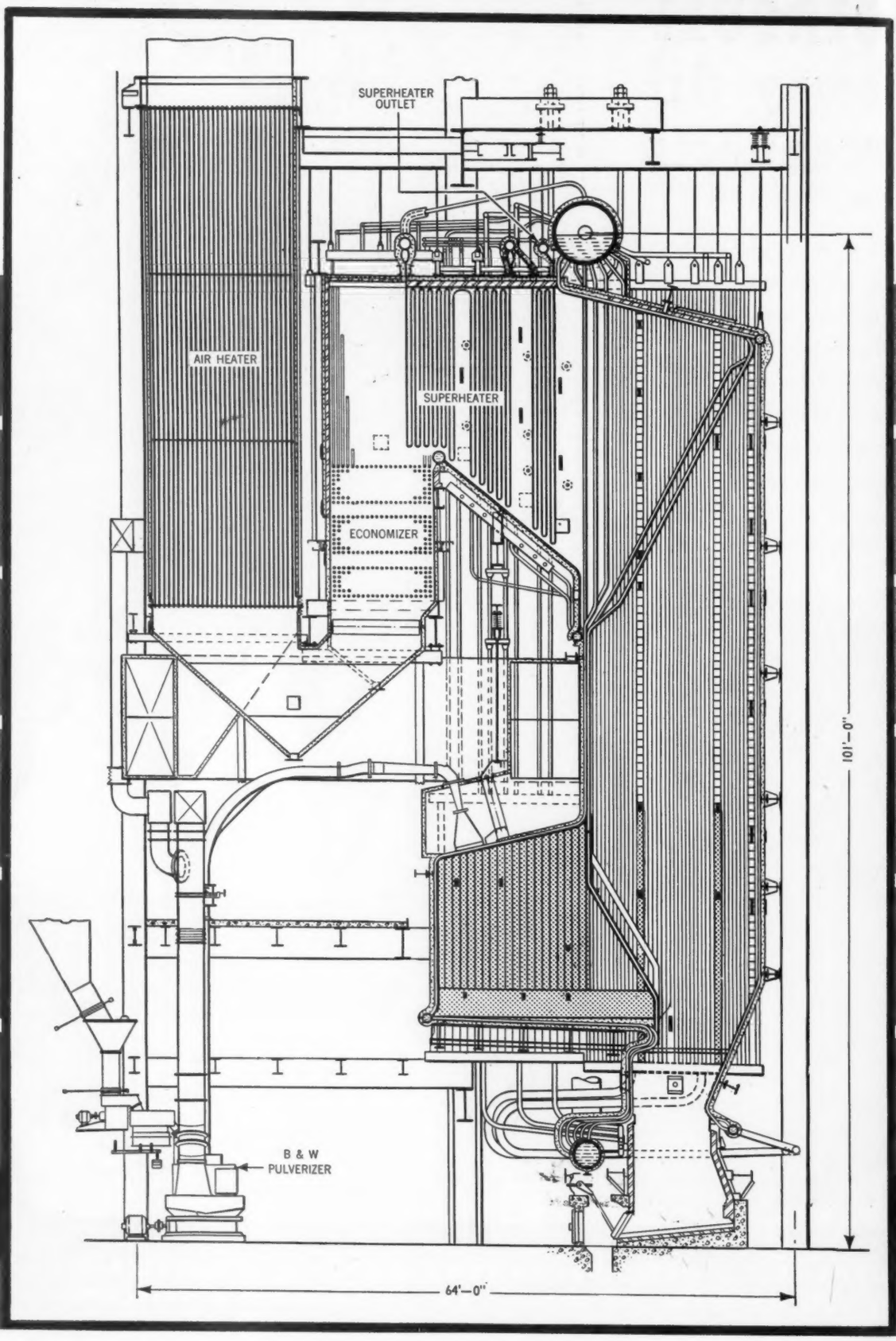
POTHEADS . . . UNDERGROUND CABLE BOXES . . . MULTITAPS
OIL FUSE CUTOUTS . . . SUBWAY OIL DISCONNECTS & SWITCHES

## G & W ELECTRIC SPECIALTY CO.

7780 DANTE AVENUE — CHICAGO, ILLINOIS

*Also made in Canada by POWERLITE DEVICES, LTD., Toronto.*

# 40 B&W


SUPERHEATER OUTLET
AIR HEATER
SUPERHEATER
ECONOMIZER
B & W PULVERIZER
101'-0"
64'-0"

# Radiant Boilers

*ordered to date*

## 15,000,000 lb. steam per hour

## Combined Capacity

*FUELS*—

Pulverized Coal

Oil and Gas

Oil, pulverized coal in future

Gas, oil, or acid sludge, with possibility of pulverized petroleum coke in future

*CAPACITIES*—

60,000 to 900,000 pounds of steam per hour

*PRESSURES*—

525 to 1525 pounds per square inch

*STEAM TEMPERATURES*—

800 to 950 degrees Fahrenheit

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET . . . . . NEW YORK, N. Y.

**BABCOCK & WILCOX**

G-202T

# *Insulation Tips*

## FOR RADIO NOISE-MINDED ELECTRICAL ENGINEERS

★

## R.I.P. Glaze Eliminates Insulator-Generated Noise

Westinghouse R.I.P. (Radio-Interference-Proof) treatment is a semi-conducting metallic oxide glaze applied to the insulator surface which becomes an integral part of the insulator during the normal firing process.

This protective R.I.P. glaze is positive in its action under all operating conditions... permanent... inexpensive. R.I.P. will never wear off, has no extra parts to install or service.

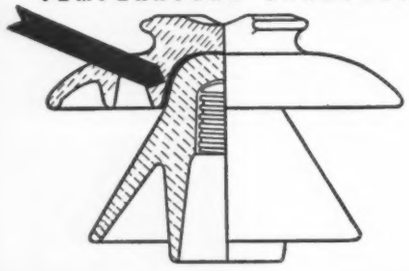
***BEFORE R.I.P.***

Capacity currents jump across the tiny air gaps that exist between conductors and insulator surfaces. These capacity arcs are miniature radio stations. Their signals are picked up at every point on the dial. Result—radio interference.

***AFTER R.I.P.***

Note what happens on an R.I.P. insulator. Capacity currents flow through contact points, but not across air gaps. No arcs . . . no radio interference.

**RESILIENT MATERIAL ABSORBS TEMPERATURE STRESSES**



## NOT A HEAD HAS *"POPPED"* SINCE WORLD WAR 1!

Early pioneer pin type insulators *did* have a weakness of "popping off" their heads. But not since World War 1 have we heard of a single Westinghouse pin type insulator being guilty of such an act.

A resilient inner lining absorbs and equalizes all temperature and load stresses—guarantees that Westinghouse pin types will keep their heads under all normal operating conditions.

# Use R.I.P. Pin Type Insulators

## FOR LOW-COST, NOISELESS TRANSMISSION LINES Up to 66 KV.

R.I.P. pin type insulators offer transmission line engineers two ways to save money . . . *plus* freedom from insulator-generated radio interference!

*On new lines*, pin types do not require the greater pole heights necessary with suspension insulators. On single circuit lines only one crossarm is needed. Third phase goes on pole top pin. This reduces pole . . . hardware . . . labor costs. *To increase voltages on existing lines*, just replace present insulators with the new pin types. No new poles are necessary, and usually, no new crossarms. The required additional ground clearance is inherent.

R.I.P. treatment eliminates radio noise formerly synonymous with pin type construction and enables you to profit by lower construction costs and rapidity of change-over. Why not investigate? Two complete and modern Westinghouse porcelain factories —at Derry, Pa., and Emeryville, Calif. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

### HERE'S HOW R.I.P. PIN TYPES RAISE LINE VOLTAGES ECONOMICALLY

***Yesterday***

When the engineers of a utility faced the problem of raising the voltage of a line, built originally under closely designed clearances, from 33 kv to 66 kv, it was a difficult one. No R.I.P. insulators were available. Therefore the line had to be rebuilt . . . new suspension insulators, new crossarms and very likely new poles were involved.

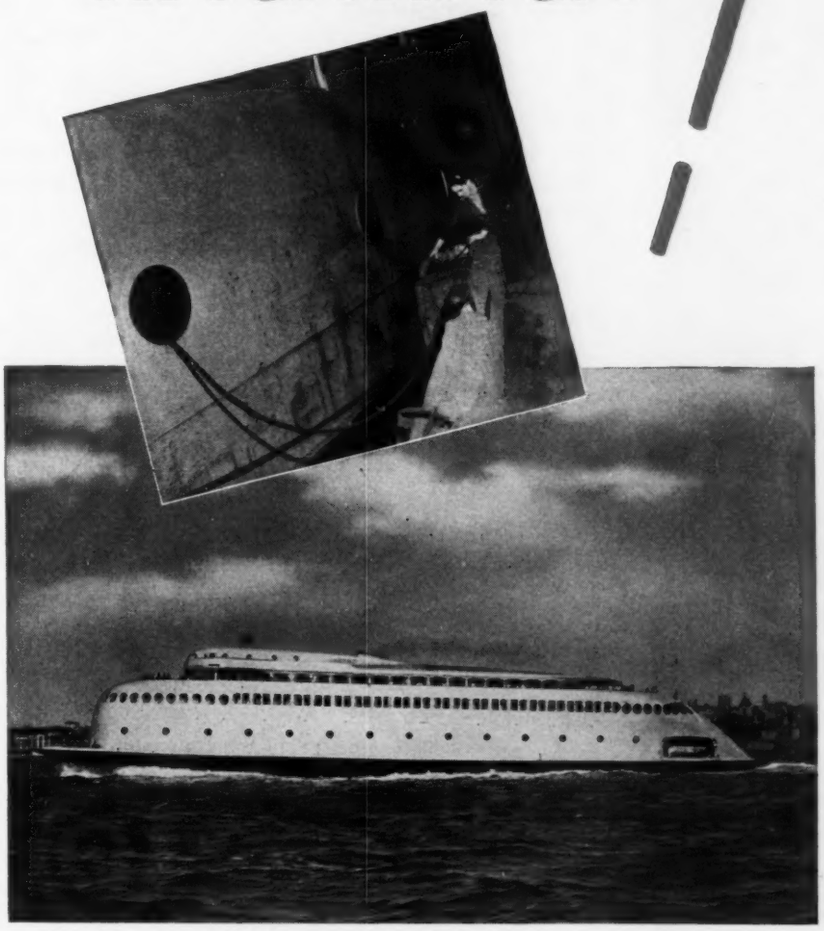
***Today***

Through the use of Westinghouse R.I.P. high voltage pin type insulators, utility engineers are able to salvage the complete line. The old suspension insulators are removed for use elsewhere and they are replaced with new R.I.P. pin types. The solution is economical and simple. The new Westinghouse R.I.P. pin types are noiseless.

J-05122

# Westinghouse Porcelain

# TIREX TAKES OVER THE LOAD ON THE 'KALAKALA'!



The streamlined ferry Kalakala has a speed of 17½ knots. She carries passengers as well as automobiles to cities on Puget Sound.

When the famous streamlined ferry Kalakala, "flying bird" ties up for the night the Puget Sound Navigation Company, her owners, have found that it is cheaper to use power from the outside than it is to keep the ferry's generators running. To make the connection between the ferry and the source of power they use a 3-conductor, #2 TIREX selenium rubber armored portable cable.

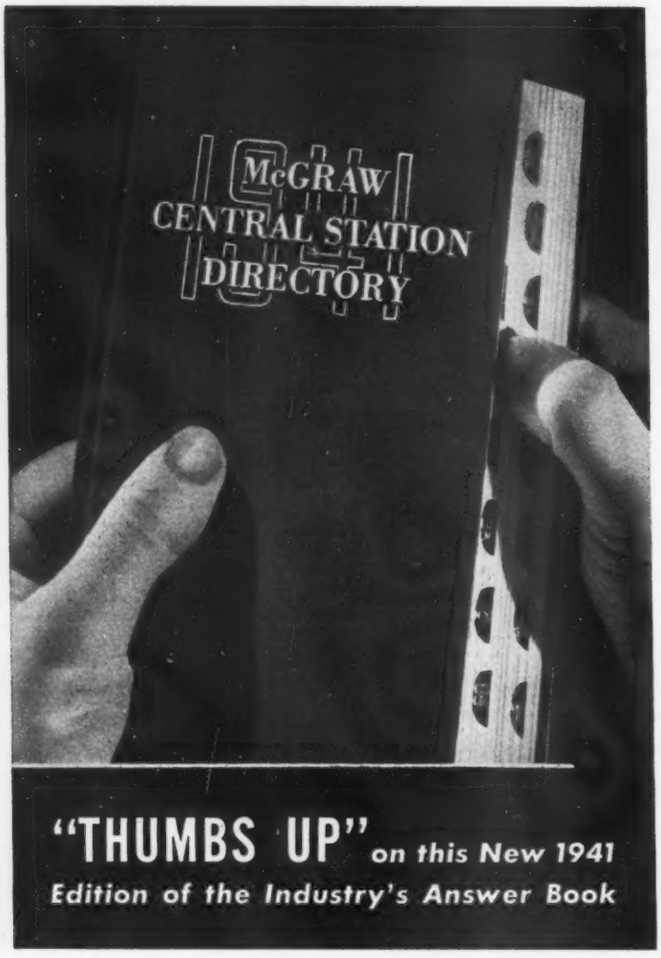
The present TIREX cable on this ferry has been in service for five years and it is still in good condition. On another one of their ferries they have a 3-conductor, #2 TIREX cable which has been in service for seven years and it is also in good condition. This is another instance of the unusual uses to which TIREX cables are put.

When you want a cable to do dependable work get a TIREX cable. The next time you need a portable cable specify TIREX.

**Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.**

# SIMPLEX WIRES CABLES

# New!




**"THUMBS UP" on this New 1941 Edition of the Industry's Answer Book**

**NEARLY 900 PAGES, sturdily bound in flexible blue Fabrikoid; fully thumb indexed; size, 4½ inches by 8½ inches. Published annually. Price $25.00 per copy; 10% discount on 5 or more copies.**

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## WHETHER YOU NEED TO KNOW THE CENTRAL STATIONS FOR ENGINEERING, STATISTICAL OR SALES PURPOSES...

# It's All There!

**Complete, Accurate, Up-to-the-Minute Data on the Organization, Personnel, Equipment and Operations of some 4000 Companies**

● Here it is—the one and only *complete* Directory, that geographically classifies all operating and holding companies in North America and U. S. Possessions . . . all plants, whether privately or municipally owned, or Government controlled projects.

Listings include names, titles and addresses of all responsible officials; full data on power generation, transmission and distribution, towns and number of meters served, etc. Also contains an alphabetical index to all companies listed—over 4000 of them—and of State Commissions and National and State Associations.

GIVES *ALL* THE DATA: McGraw Central Station Directory literally stands alone in its field—it is the only *complete* source of information.

Manufacturers, Distributors, Consulting and Power-Sales Engineers—and the Central Stations—find this a strictly indispensable sales and engineering aid every working day of the year.

NEW DATA ADDED: Every Edition of the Directory in the past 37 years has presented new and valuable information as soon as available. In this new 1941 Edition, these important new data have been added:

—All recorded SEC mergers and consolidations.
—Approximately 250 new Rural Cooperatives.
—Over 100 new municipal operations.
—Latest U. S. Census population figures.

**SOON READY: Presses are rolling right now on this "Open Sesame" to the Central Stations . . . should be ready for delivery as soon as your order is in. You'll want to set it to work immediately, while its information is still news-fresh. Be sure you get your twelve full months of service from it, by ordering TODAY!**

# How You Can Double Your Annual Revenue From Institutions

## EDISON-HOTPOINT

### Electric Cooking Equipment for Commercial Use Helps Gain Valuable Load

MAKE hospitals, schools and other such institutions great revenue builders for your company by selling them electricity for cooking and baking in addition to the electricity you sell them for lighting and power uses.

The addition of this load can double the kilowatt hours which institutions use. You have the equipment to make such customers 100% electric because the cooking and baking demand is not super-imposed on the lighting and other demands. It is really off-peak in institutions, yet your KWH sales are doubled.

New low prices now place Edison-Hotpoint Electric Cooking and Baking Equipment within easy reach of all institutions.

Study Edison-Hotpoint's "Analysis of Profit Possibilities" on commercial cooking. We will gladly present this story, together with a complete plan for securing commercial cooking load. Send the coupon now! Edison General Electric Appliance Co., Inc., 5618 West Taylor Street, Chicago, Illinois.

*Distributed in Canada by Canadian General Electric Co., Ltd., Toronto*

### Dollars to Doughnuts

How many of your retail baker customers operate electric ovens? They buy your service for lighting, mixers, dividers, molders, slicers, wrappers. Why not add the revenue which an Edison-Hotpoint Electric Bake Oven produces? This oven in a bake shop doubles your KWH sales to such a customer.

The new Edison-Hotpoint Electric Oven heats up 25% faster, holds heat 35% longer and is priced lower than ever. Bakers can afford to buy now. Double your revenue from bakers by going after this important load. Send coupon for Analysis.

**←EDISON-HOTPOINT'S "Champ" Heavy Duty Electric Range**
**Big capacity in small space. A 24" x 36" cooking top in a range only 3 feet wide. Top surface units available in wide variety for utmost service. Convenient, large capacity grease trough and easy draining receptacle for griddle top units. Famous Calrod heating elements for speed and economy. Sectional top and oven section available separately. Cabinet base (or plate storage section) can be furnished instead of an oven section.**

*For sale through leading Kitchen Equipment Houses*

**EDISON Hotpoint**

**COMMERCIAL ELECTRIC COOKING EQUIPMENT**

Boston New York City Atlanta Cleveland Chicago Kansas City Dallas Los Angeles Seattle Salt Lake City

Edison General Electric Appliance Co., Inc.
5618 West Taylor Street, Chicago, Ill.

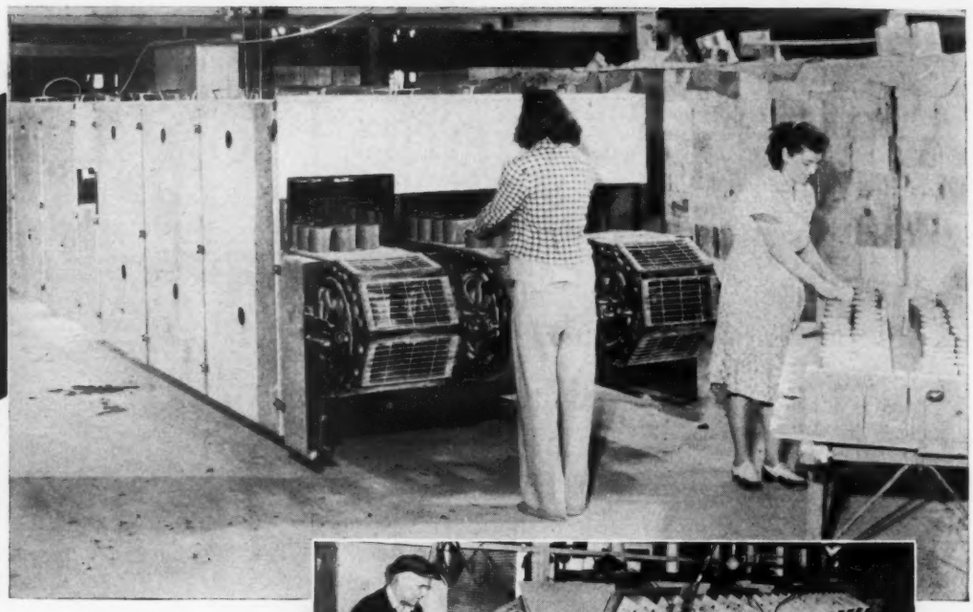
We will be pleased to have you present your "Analysis of Profit Possibilities" together with Plan.

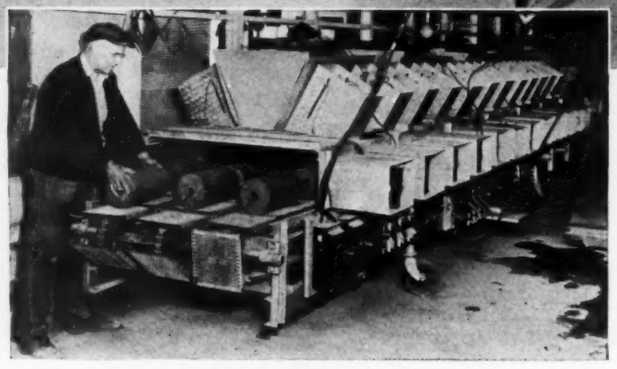
*Name* _____

*Address* _____

*City* _____ *State* _____

# FIRST AGAIN!





## A Victor Discovery of Utmost Importance to the Entire Electrical Industry . . . . . .

Realizing that the Sun was the best dryer of clay from time immemorial Victor Engineers decided to control its action to avoid the uncertainty of all of the trying delays and losses prior to forming and firing porcelain.

We developed the answer—two infra-red units, which are now operating on a regular production line. They automatically control the moisture content and the speed of drying of our clay preparatory to firing.

This development is of great importance to the entire industry because—

Strains which usually show up on Thermal tests are avoided. ★ Accuracy of Dimensions is assured. ★ Production is speeded up by definite drying time control. ★ Uniformity of Porcelain Quality is assured. ★ Actual record cases show 6 days from clay bin to shipping room door. ★ Use of Infra-Red Rays is an electrical load builder. ★ Saves Fuel by eliminating steam coils.

V *The Mark of a* **GOOD** *Insulator*

# VICTOR INSULATORS, INC.

## VICTOR, NEW YORK

# Oliver "SAFETY-LOCK"

## STOPS SCREW-LOOSENING IN WIRE HOLDERS

"Strength at every point of service" has always described the Oliver Wire Holder and NOW a new *plus feature* adds strength and stops screw-loosening . . . the Oliver "Safety-Lock."

This new Oliver development is an upset shoulder at the base of the screw which locks it safe from loosening, makes the screw permanently rigid—lets you "slam-in" the Oliver Wire Holder for faster, surer driving.

Sharp, full threaded screws drive easily and the heavy galvanized steel frame assures strength and long service. The wire hole (a full $1\frac{1}{8}$"), accommodates any normal sized service wires.

Just try Oliver Wire Holders (No. 2515) on one job, then you'll appreciate the value of all these advantages plus "Safety-Lock" construction. Leading electrical equipment jobbers everywhere are ready to supply you.

**OLIVER IRON AND STEEL CORPORATION**
*Makers of Pole Line Hardware Since 1894*
**PITTSBURGH, PENNSYLVANIA**

OLIVER
POLE LINE MATERIALS

APPROVED AND ACCEPTED SINCE 1894

This turbine will be a dependable source of power for many years — it is lubricated with Gulfcrest, as recommended by the Gulf engineer shown at the left.

"For maximum protection of this new turbine, we have standardized on

# GULFCREST OIL,"

says the Chief Electrical Engineer in this paper mill.

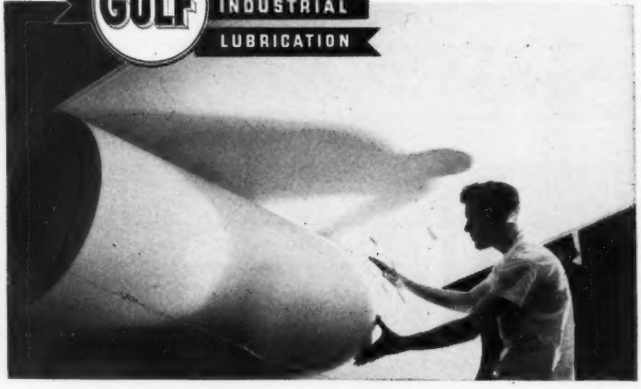
## 4 REASONS

### WHY GULFCREST OIL IS THE TURBINE LUBRICANT OF UNMATCHED QUALITY

1. REFINED BY THE ALCHLOR PROCESS. The most thorough and effective method for removing chemically active hydrocarbons as well as the general run of impurities present in all crudes.
2. HIGHEST RESISTANCE TO OXIDATION. Because this famous ALCHLOR Process synthesizes and rearranges the molecular structure of certain hydrocarbons, resulting in a finished product of greater stability, GULFCREST OIL stands alone in its high resistance to oxidation.
3. HIGHEST RESISTANCE TO ACIDITY AND SLUDGE. Because of the elimination of oxidation catalysts in addition to the unparalleled refining power of the Alchlor Process, these oils form less gum and deposits, less emulsion and sludge, when mixed with water over a period of several years continuous operation, than any other turbine oil of which we have record.

4. HIGHEST KILOWATT-HOUR PERFORMANCE. Because Alchlor not only makes possible an oil more thoroughly refined and homogeneous, but also creates anti-oxidants, these oils have great resistance to deteriorating influences and are longer lived. Less makeup oil is required.

GULF INDUSTRIAL LUBRICATION



***"Right from the start we insured against trouble due to Turbine Oil Deterioration."***

"This turbine must be a dependable source of power for a good many years to come," says the chief electrical engineer in this plant. "That's why we standardized on Gulfcrest Oil to lubricate it right from the start. This oil shows remarkable ability to retain its original characteristics without deterioration."

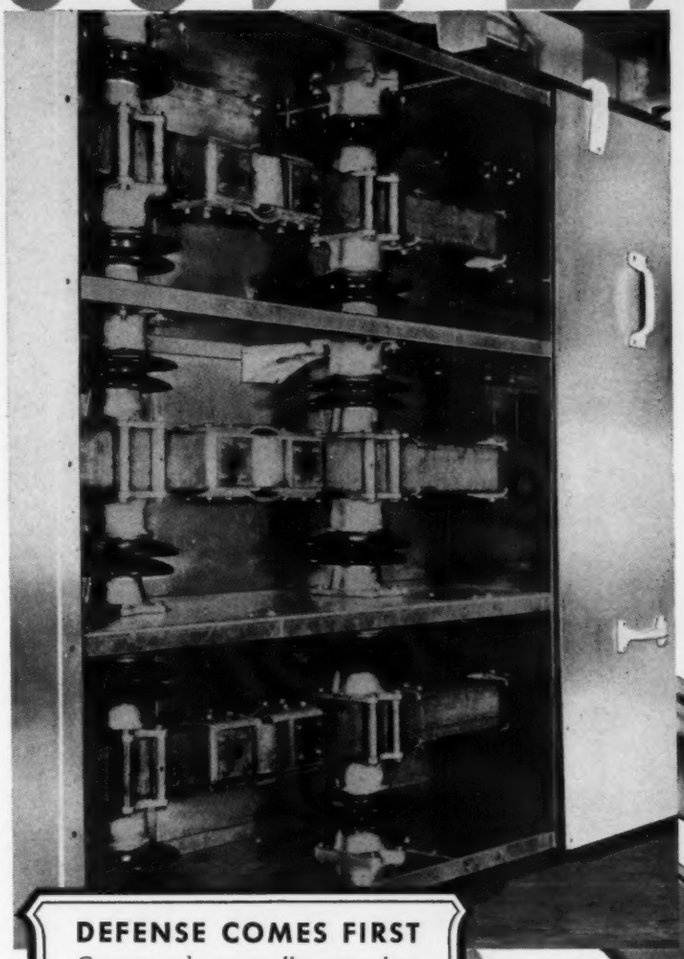
Turbine operators from Maine to New Mexico who have standardized on Gulfcrest Oil are finding that it is the most stable turbine lubricant they have ever used. Here is the reason: *Gulfcrest Oil is especially refined and purified by the Alchlor Process,* the most efficient method yet developed for removing undesirable hydrocarbons and other impurities which cause oxidation and sludge formation.

There is a *real quality story* behind Gulfcrest Oil. Ask the Gulf engineer in your vicinity to give you complete details.

**GULF OIL CORPORATION · GULF REFINING COMPANY**
**GULF BUILDING, PITTSBURGH, PA.**

# COPPER

## —means more efficient bus conductors



Because of its high conductivity and consequent low current losses, copper has always been the most widely used material for bus conductors. To these advantages may be added such further qualifications as high thermal conductivity, high strength, high resistance to corrosion and ready availability of accessory equipment. Thus it is that copper lends itself to more efficient bus constructions.

Wherever modern electrical engineering practice dictates bus construction embodying structural strength, low ohmic and reactance loss or effective heat dissipation, the range of copper bus shapes made by The American Brass Company will meet every requirement.

The complete line includes flat bars, tubes, cables and angles and channels for ventilated structures. Descriptive literature and advice of our technical staff are available on request. 43127

*Photo at left courtesy I-T-E Circuit Breaker Company.*

**CHANNEL SQUARE**
Maximum Current in Minimum Space

**TUBULAR**
Lowest Losses

**ANGLE SQUARE**
Maximum Current with Minimum cross section

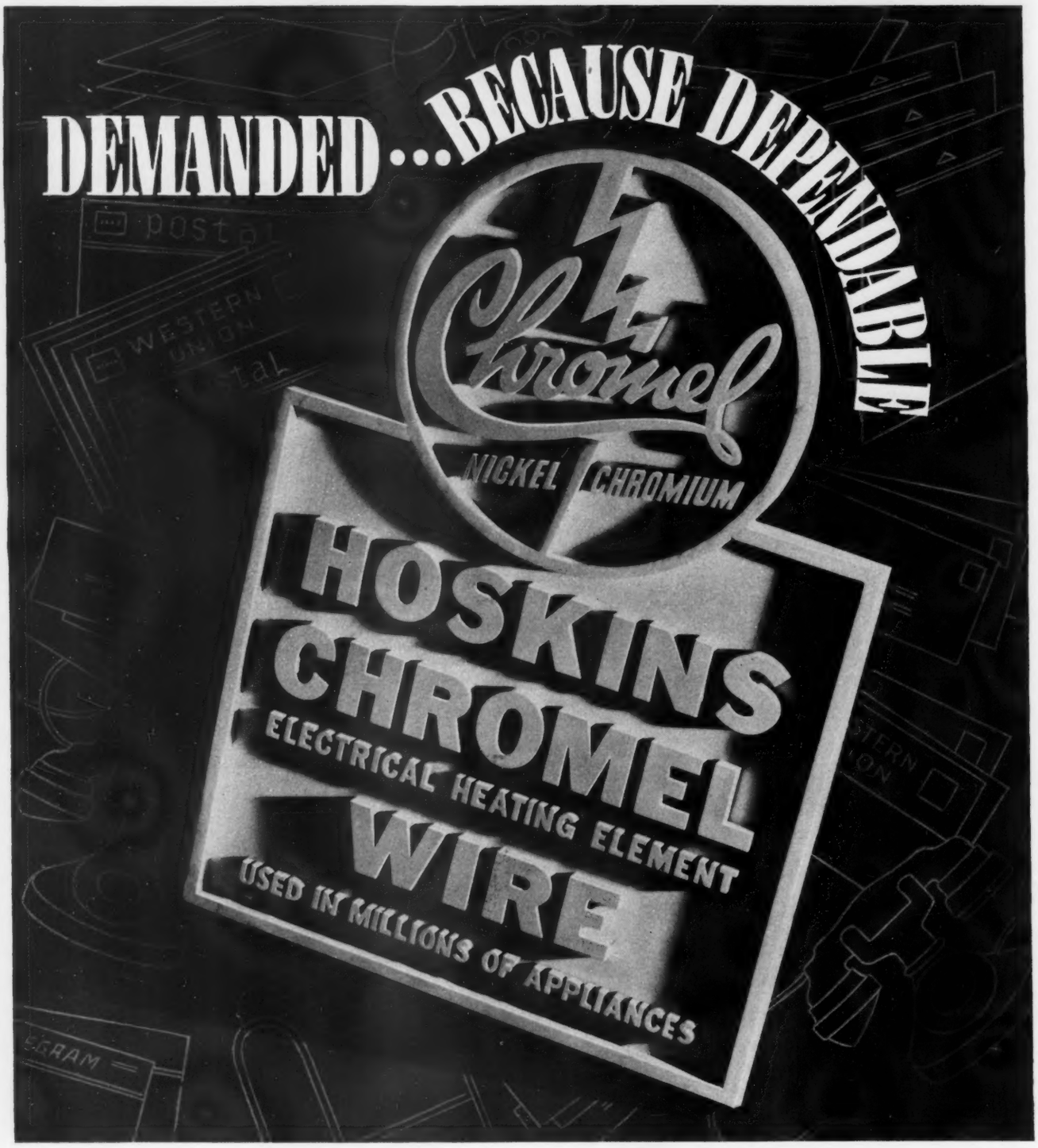
### DEFENSE COMES FIRST

Copper and copper alloys are playing an indispensable part in the National Defense Program. Recognizing the responsibility placed on us, we are exerting every effort to fulfill our part in the tremendous task created by the emergency. In the United States and Canada, our ten plants serving important industrial centers are working to the limit of their ability to increase the output of products for which the demand is greatest. We feel sure consumers will appreciate the problems which confront us and will cooperate fully in our efforts to plan production beyond defense requirements so that all customers will receive every consideration.

ANACONDA

*Anaconda Copper*

THE AMERICAN BRASS COMPANY • General Offices: Waterbury, Conn.
*Subsidiary of Anaconda Copper Mining Co.* In Canada: Anaconda American Brass Ltd., New Toronto, Ont.




These days, Chromel is hard to get—and we both know the reason. But "our's not to question why—our's but to do or die!" . . . With defense naturally having the first claim on nickel, with our share of what is left for the rest of us, we are doing all we can to treat all Chromel customers fairly. And always remember that though Chromel be scarce in available quantity, its quality is just as reliably good as always. Its durability, better than ever. If you want technical data on Chromel, ask for Catalog-L . . . Hoskins Manufacturing Company, Detroit, Michigan.

**HOSKINS MANUFACTURING COMPANY** DETROIT, MICHIGAN

• • YOU GET SHORTER OUTAGES WHEN YOU • •

# Clear Faults Instantly WITH PACIFIC ELECTRIC

## AUTOMATIC SERVICE RESTORER

*Superior Protection*

**FOR RURAL OR LOW-REVENUE DISTRIBUTION LINES • • •**

***DEPENDABLE AND SAFE***

Service can now be restored *quickly* on rural or low-revenue distribution lines—when you clear faults instantly with Pacific Electric's hand-wound Automatic Service Restorer.

You get protection against four faults and reclosures following three faults, automatically, at predetermined times without rewinding. On sustained shorts, lockout occurs on the fourth opening.

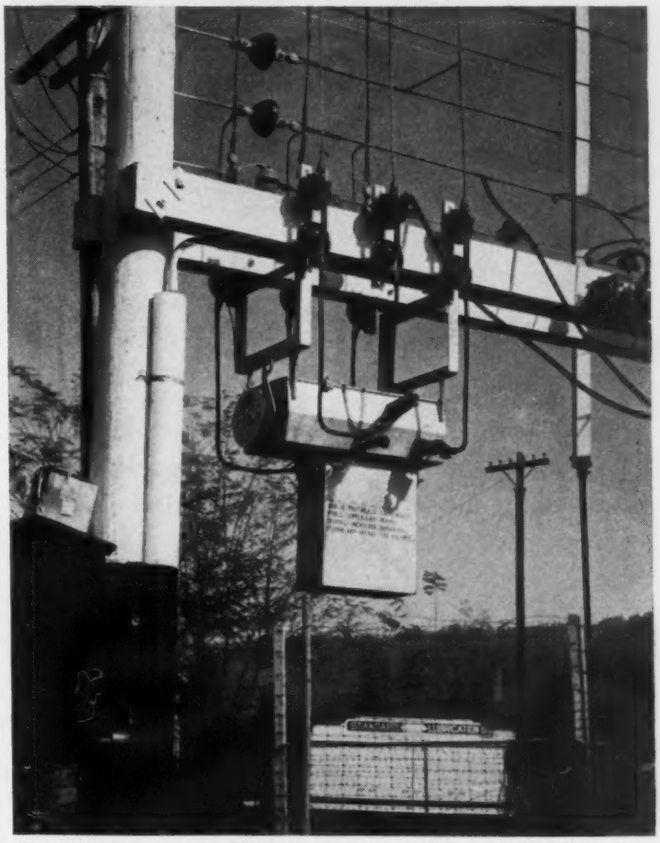
Unlike fuses, the low-cost Automatic Service Restorer does not emit flashes. Lines protected with fuses may have outages of several hours duration, but the Service Restorer reduces such outages to momentary interruptions on intermittent faults.

No hot parts need be handled. Single-phase operation of three-phase equipment and dangerous feed-backs are prevented by the simultaneous opening of all poles of three-pole restorers.

Made by the Pacific Electric Mfg. Corporation, the Automatic Service Restorer has won a wide reputation among scores of utilities for reliable operation even during severe storm conditions in the protection of distribution feeders.

Its operating energy is stored in a reliable spring, easily wound by hand and its number of remaining operations are clearly visible by any attendants or line patrolman.

Get all the facts on clearing faults instantly with the *reliable* and *safe* Automatic Service Restorer. Write today.



The Automatic Service Restorer may be mounted as shown above or on the Crossarms of a single pole.

*Type AP-1, 7.5/12.5Y-kv, and Type AP-2, 15-kv, Automatic Service Restorers are easily wound by hand and are made in Single-, Double-, and Three-Pole units, both 100 a., 60 cycles. Motor-wound Automatic Service Restorers also available in the same ratings.*

C. H. CUTTER
1006 Securities Bldg.
Seattle, Wash.

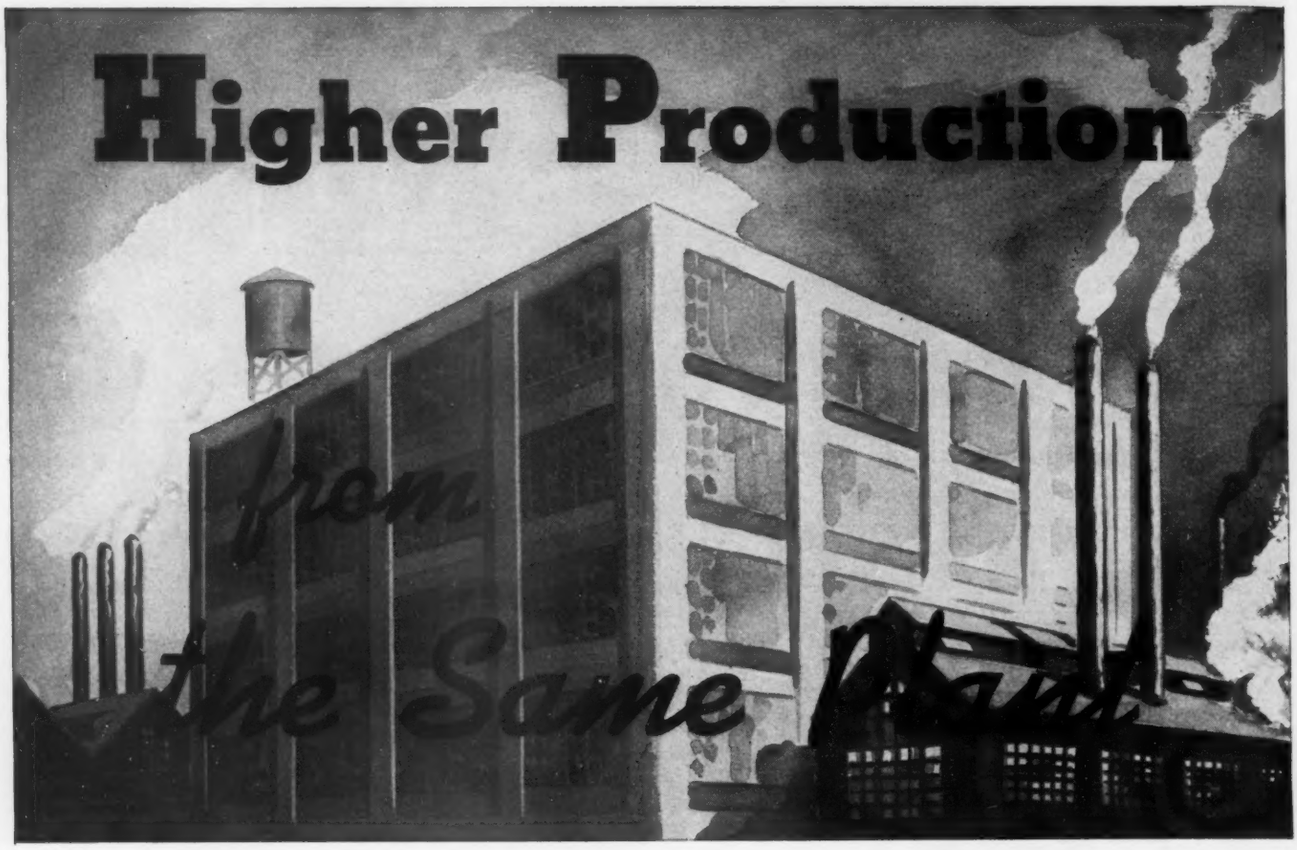
U. N. HALLIDAY
230 U. S. Nat'l. Bank Bldg.
Denver, Colo.

G. B. KIRKWOOD
437 S. Hill St.
Los Angeles, Calif.

*Other Representatives in Principal Cities*

**Pacific Electric Mfg. Corporation**

5815 THIRD ST., SAN FRANCISCO, CALIF. DUNES HIGHWAY, GARY, INDIANA




# Modernize Material Handling...

CHANCES ARE the old machines never did produce as much as they could! Time and again it has been demonstrated that a change in the method of handling materials has stepped up a plant's capacity. In many factories battery industrial trucks are modernizing handling methods with an amazing increase in plant output.

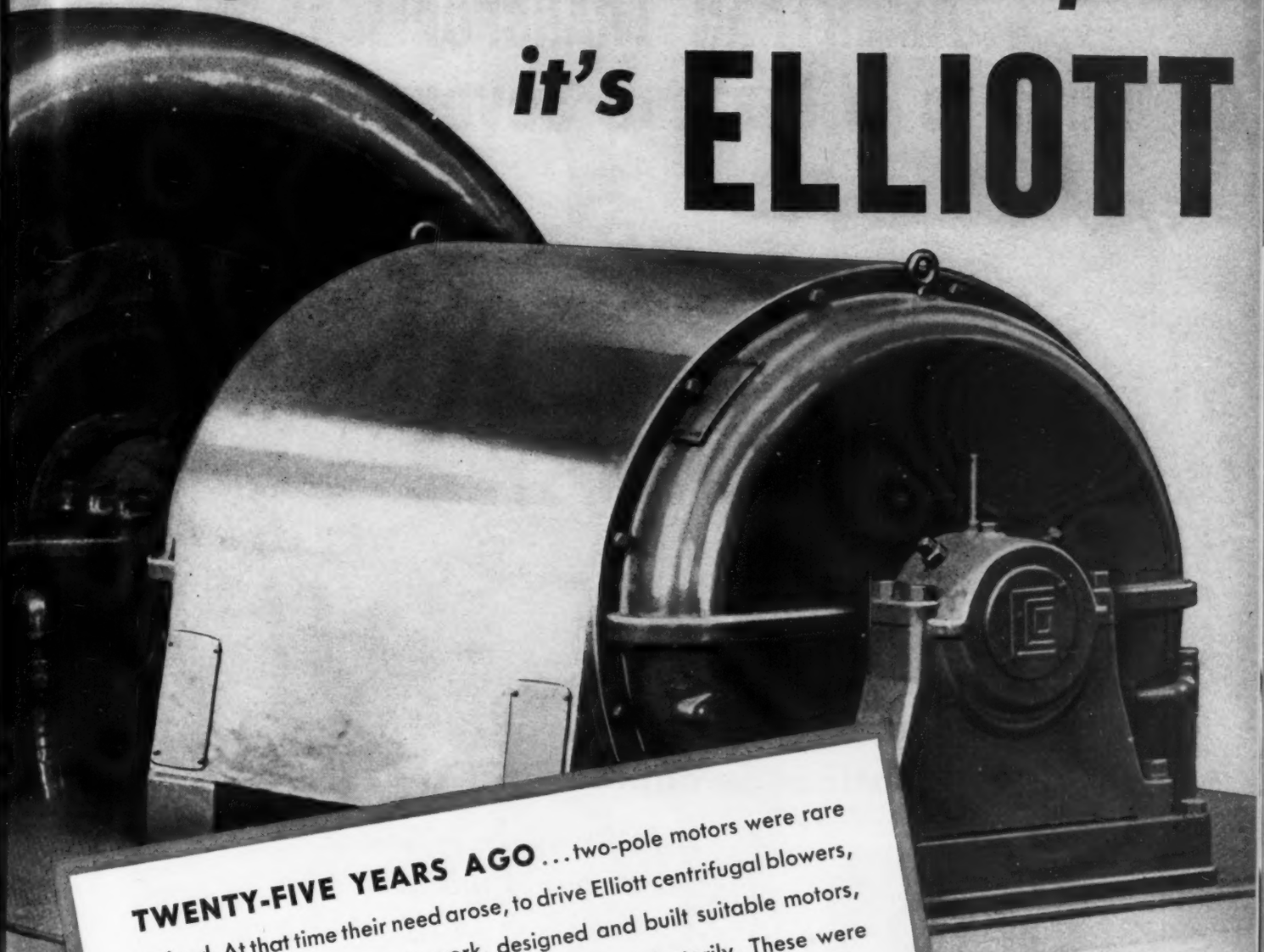
***First, get the right truck for the job...*** then put the right power unit in the truck. An Edison *Steel* Alkaline Battery has no moving parts to get out of order. Almost never needs repairs. Gives off no fumes. Makes no noise. And—is the surest, safest means of operating a modern truck 24 hours a day, every day. It is the most reliable of all batteries. With cells built of nickeled ***steel***, it is stronger. Uses an alkaline electrolyte which is a preservative of nickeled ***steel***. It has two to five times longer life than other batteries—costs least per year.

For more detailed information send for our bulletin MODERN MATERIAL HANDLING. New edition, just off the press, describes the various industrial-truck handling systems; illustrates the latest methods; gives detailed data on alkaline batteries. Edison Storage Battery Division of Thomas A. Edison, Inc., West Orange, New Jersey, U. S. A.

**Edison**
**STEEL *Alkaline* BATTERIES**

# In Large Motors at 3600 r.p.m.

# it's ELLIOTT



**TWENTY-FIVE YEARS AGO** . . . two-pole motors were rare indeed. At that time their need arose, to drive Elliott centrifugal blowers, and Elliott engineers set to work, designed and built suitable motors, the first of which is actually still operating satisfactorily. These were 1500-hp., 3600-r.p.m. synchronous, and 1500-hp., 3600-r.p.m. squirrel-cage motors.

With this sound foundation of experience, Elliott has since successfully specialized in large motors at 3600 r.p.m. supplying them for various big high-speed drives, such as blowers, boiler-feed pumps, etc.

Elliott builds both synchronous and induction motors in all types over 25-hp., designed for specific conditions.

**REAL MOTOR INFORMATION**

*The Elliott Motor Bulletin is complete and informative. Write for a copy, stating type of motor in which you're interested.*

L-726

# ELLIOTT COMPANY

*Electric Power Department*

RIDGWAY, PA.

DISTRICT OFFICES IN PRINCIPAL CITIES

# AMERTRAN TRANSFORMERS
# Built to Withstand Severe Demands

## In spite of continuous operation, exposure, overloads

View of standard Type RS Distribution Transformer with cover removed, showing arrangement of terminal board, leads and bushings.

- *they insure efficiency*
- *minimum maintenance*
- *protection to life and property*

AmerTran Type RS Transformers are built to meet these exacting requirements by an organization with 40 years of experience in transformer manufacturing. Consider the features itemized below before you make a selection.

**1. May be completely dismantled and reassembled with wrench.**

**2. Stud-type bushings of coordinated flashover type—easily replaced and syphon-proof.**

**3. External parts rust resistant . . . tanks and covers of copper-bearing steel.**

**4. Patented clamps permit removal of coil after end iron only has been taken out.**

**5. Shipped filled with oil to reduce transportation expense.**

**6. Coils of fully balanced design, vacuum impregnated in varnish, have large ventilating ducts.**

**7. Rigid core construction prevents damage from momentary short circuit and rough handling.**

**8. Similar electrical and mechanical design for sizes from 1½ to 100 Kva., 8000 volts and below.**

**9. Available with additional surge protective devices.**

**10. Meet all provisions of the new E.E.I.-N.E.M.A. specifications.**

AMER TRAN

• *WRITE for your copy of Catalog No. 116 describing the complete line of AmerTran Distribution Transformers. It lists all standard ratings (with prices) in capacities to 500 Kva. and potentials to 66 Kv.*

AMERICAN TRANSFORMER COMPANY
178 EMMET ST.
NEWARK, N. J.

AMERTRAN

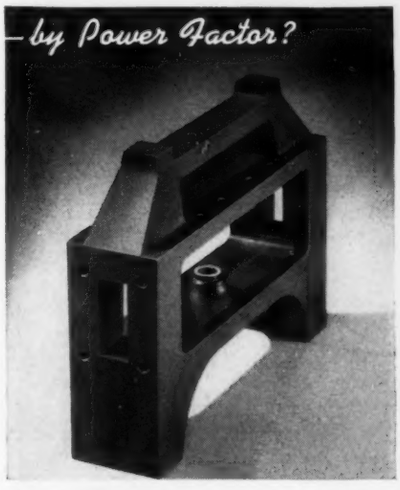
Manufactured
Since 1901
at Newark, N. J.

# How do *You* measure the efficiency of insulating materials?

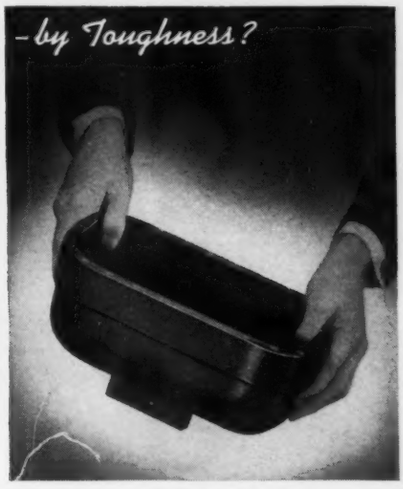
Once the necessary dielectric strength is assured, what other factors do you consider in gauging the efficiency of insulating materials? Toughness and ability to resist impact shocks? Stability under high temperatures? Power factor or resistance to moisture? All of these important characteristics, and numerous others, are readily available to you in BAKELITE Plastics.

These high dielectric materials are offered in many basic types, including Ureas, Polystyrenes, Acetates, and Phenolics . . . in forms that are adaptable to every production and maintenance requirement. They include not only hundreds of molding plastics, and laminating materials, but also cast resins, tapes and films, coatings, and cements.

Our Engineering and Laboratory Advisory Service will welcome an opportunity to help you solve specific insulation problems with BAKELITE Plastics.




LOW POWER LOSS is essential to the efficiency of high frequency equipment, such as this Leeds & Northrup Capacitor Frame. Sturdy construction, also, is important. Therefore, the frame is molded from a specially developed BAKELITE *low loss* Phenolic Plastic known as BM-262. The power factor of this material at 60 to 1,000,000 cycles is 0.025 to 0.007. Its dielectric constant in the same frequency range is 5.5 to 5.0.




HIGH MECHANICAL STRENGTH is as necessary as high dielectric strength for the transformer oil container of the Keleket X-ray unit. This part must provide support for the heavy transformer, and safely insulate 90,000-volt conductors molded within its walls. These requirements are met fully by a shock-resistant BAKELITE Plastic. A.S.T.M.-Izod impact strength for this material is 1.9 to 2.7 (foot-pounds energy to break).

CABLE REELS used by repair crews are subjected to rain, heat, and cold, and the general abuse of constant outdoor use. To withstand such severe service, the Epcolight reel shown above is made entirely from a tough laminated plastic (Lamicoid). Because this material is an excellent insulator, the electrical outlets are incorporated in the plastic sides of the reel. These durable reels are now standard equipment with Consolidated Edison Company of New York.

BECAUSE of their unusual resistance to heat, plastics are used widely both in the manufacture and maintenance of electric motors ranging from 5 hp. to 5,000 hp. The shells for the field coil shown above are cut from sheets of laminated plastic material (Micarta). Even though operating temperatures may rise to 350°F., this material still provides effective insulation. Furthermore, because of its exceptional toughness, it withstands winding tensions and centrifugal stress.

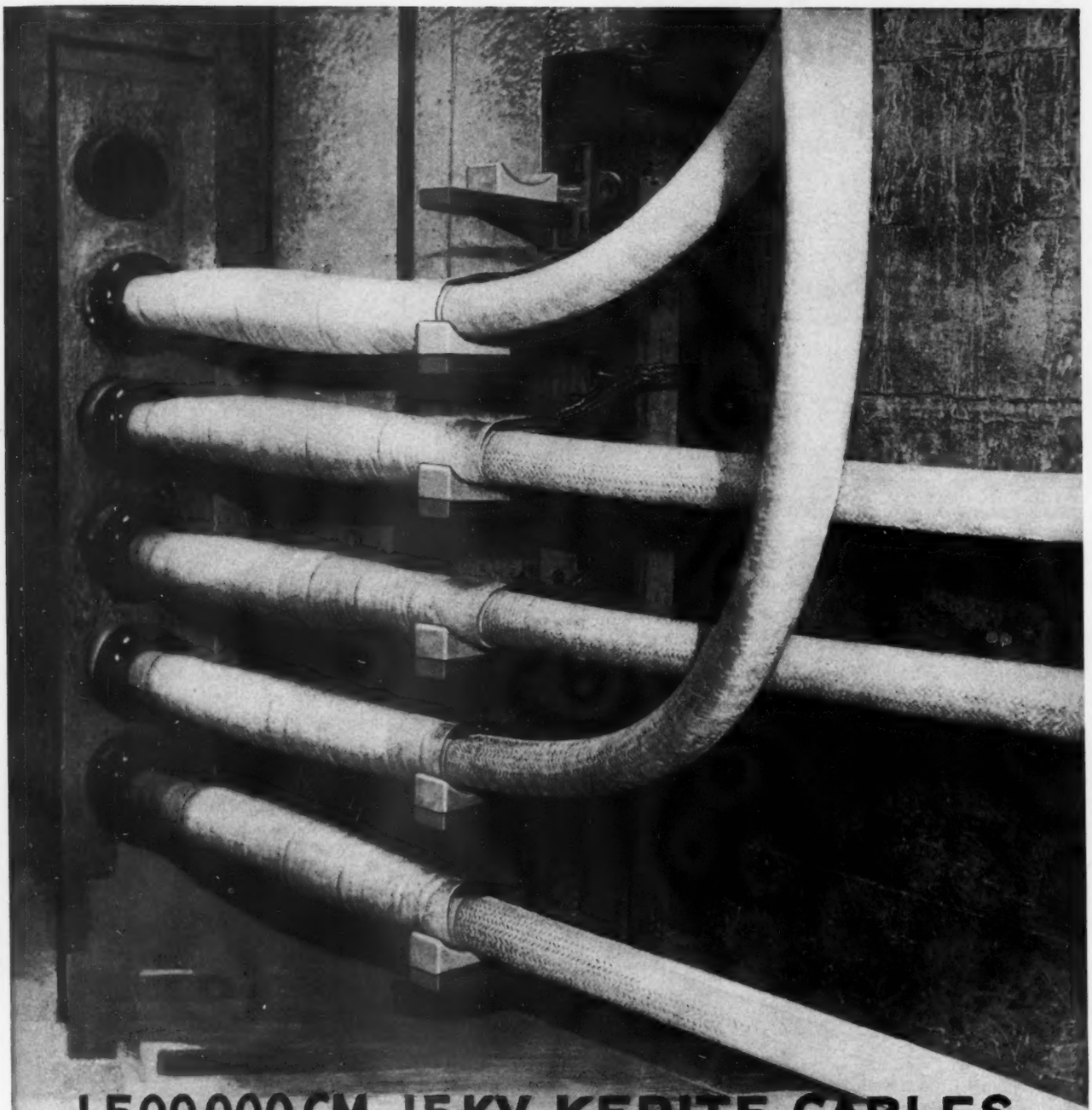
BAKELITE CORPORATION, 30 EAST 42ND STREET, NEW YORK, N.Y.
*Unit of Union Carbide and Carbon Corporation*

UCC

**BAKELITE**
TRADE MARKS

The word "Bakelite" and the identifying products Symbol are registered trade-marks of Bakelite Corporation

**PLASTICS HEADQUARTERS**



# 1,500,000 CM 15 KV KERITE CABLES
# CAHOKIA STATION

**UNION ELECTRIC LIGHT AND POWER CO., ST. LOUIS**

***INSTALLED 1927***

DAYS KERITE

THE KERITE INSULATED WIRE & CABLE COMPANY INC

NEW YORK CHICAGO SAN FRANCISCO

# the 37th inch on the L-M yardstick

The competition towered forbiddingly high back in 1911, when L-M hung out its shingle. It was the youngest and smallest manufacturer serving public utility companies.

But the 37th inch on the L-M yardstick — personal attention — seemed somehow to compensate our customers for the limitations of our earlier years. At the very beginning L-M made it its business to know and meet the needs, likes, and preferences of its customers.

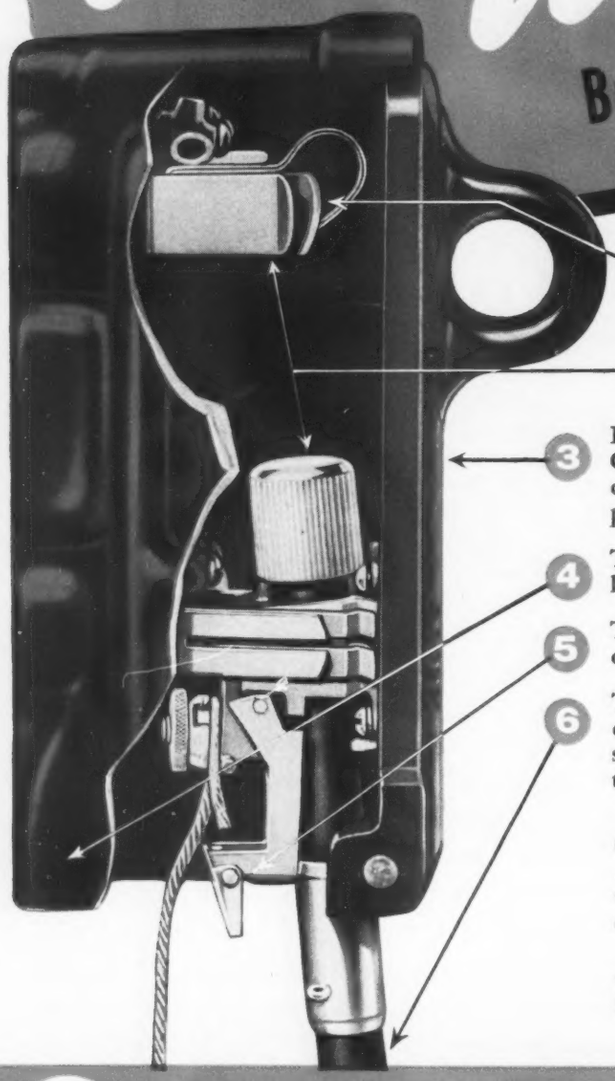
L-M established its research division years ago. It has already made notable contributions to the industry. More are expected and they, too, will be efficiently manufactured in our factories — distributed by our nation-wide branch offices and warehouses. The L-M line now has broadened until it requires an 8-pound catalog to describe it.

But that 37th inch has remained on the L-M yardstick — an intangible that seems as popular today as ever. To continue to give it, we shall be happy to remain a "shirtsleeve" company, no matter how much we may grow.

## LINE MATERIAL COMPANY

# The L-M "PVD" Fuse Cutout is *First in all ways*

## Because of these Factors



1. Large-area, safe, cool contacts which efficiently dissipate heat, insuring cool and safe operation and extremely long service life.

2. Extra large air gap between contacts in blown position. This eliminates arcing and leakage and prevents re-establishment of the arc.

3. Reliable performance is safeguarded in the PVD Fuse Cutout because the bakelite door stays closed when cut-out is in fused or blown position. Therefore, working parts are always protected from the weather.

4. The housing of the PVD is cast of wet process porcelain and is designed to withstand the roughest treatment.

5. The *original* PVD flip-out device jerks the blown link out of the tube the instant it melts.

6. The tell-tale position of the drop-down cartridge is easily seen from the ground, enabling trouble to be spotted quickly and considerable time saved in locating the blown link.

All of these features were originated by Line Material Company in its constant effort to improve its products . . . L-M was first with an indicating cutout, was first with wet-process porcelain housing, first with a drop-out cutout.

All these features are fully described in bulletin No. 41101 which will be sent upon request, or which can be secured from any L-M representative.

**30 Years of L-M Service**

At any time, it is easy to check any L-M HEAVY-DUTY Lightning Arrester right on the line, without costly laboratory or field tests. You are always sure that your L-M Arresters are in perfect condition.

The double "elastic" seal keeps out moisture and prevents gap corrosion . . . no leakage to ground, no radio interference.

The special L-M valve material handles high-amperage and long-tail surges equally well and due to its characteristics, holds internal resistance (IZ drop) to low values at all surge currents.

The L-M valve material is chemically and electrically absolutely stable, does not change its characteristics in operation and assures the same unfailing operation even after years of performance.

An added feature, only found in L-M HEAVY-DUTY Arresters, is the ISOLATOR (Pat. Pending). Any arrester might become damaged at some time in service. The L-M ISOLATOR will then save you time and money because it will automatically cut off the faulty arrester from the line, preventing feeder lock-out or phase grounding.

Detailed information further explaining and illustrating the reasons why these features contribute to better service is covered in bulletin LMB-40151. Write for it to Line Material Company, Milwaukee, Wis.

**LINE MATERIAL COMPANY**

# No other Transformer has all these 5 features

**1 BETTER REGULATION AT *ALL* POWER FACTORS!** Inherently low reactance is the natural result of ROUND-WOUND coil construction. Compact winding of round coils eliminates winding bulge and airgaps between layers. The desirable ratio of coil length to thickness reduces leakage flux.

Lower resistance, or IR drop, due to reduced copper loss, is obtained by the elimination of turns in the ROUND-WOUND coil. The inherent advantages of the wound core permit this without sacrificing low exciting current.

Lower impedance is the natural consequence of decreased reactance and resistance.

The combination of lower reactance, lower resistance and lower impedance results in improved regulation at *all* power factors.

**2 BETTER LOSS RATIO!** The ROUND-WOUND construction permits the elimination of turns in the round coil. The result: a substantial reduction in copper losses at very slight expense in core loss. Total losses are lower. Voltage regulation on overloads is improved.

**3 UNIFORMLY LOW EXCITING CURRENT!** Machine wound and undisturbed after annealing, the ROUND-WOUND core is practically void of airgaps, the cause of high exciting current.

**4 UNIFORMLY HIGH IMPULSE STRENGTH!** In winding a round coil the "human element" which accounts for variations in impulse strength and uniformity, is greatly reduced. No sharp bends. No tapping to damage conductor and insulation. Minimum tension on the wire. All this assures high impulse strength.

**5 HIGH SHORT-TIME OVERLOAD CAPACITY!** Because ROUND-WOUND coils are of the long, round type with a minimum of their surface enveloped by the iron circuit, they have a relatively large radiating surface exposed to the oil. As a result, "cool running", high short-time overload capacity is assured.

Of course, L-M ROUND-WOUND Transformers incorporate all new E. E. I. and N. E. M. A. approved standards. They are available in 1½ to 25 Kv-a, 2400 to 7620 volts ratings.

ROUND COILS WOUND CORE

## WHY L-M HAS ALL 5 FEATURES

**The L-M ROUND-WOUND Transformer is distinctly different from any other transformer because L-M found a way to do the hitherto impossible of winding round coils directly onto a wound core of hot-rolled silicon strip steel without disturbing the core after annealing.**

**If you have not yet seen bulletin LMB-41161, fully describing the L-M ROUND-WOUND Transformer, its construction and features, a copy will be sent to you upon request to Line Material Company, Milwaukee, Wisconsin.**

LM

# LINE MATERIAL COMPANY

## J. L. HEMPHILL & CO. Inc.
ELECTRICAL ENGINEERS AND EQUIPMENT
1600-1604 53rd Street, North Bergen, N. J.
N.Y.C. Tel.: LOngacre 5-3227—N.J. Tel.: PAlisade 6-2600
HOWARD B. JOHNSON, 53 W. Jackson Blvd., Chicago, Ill., Chicago Representative

**MOTOR GENERATOR SETS**

1—500-kw., 600 volt, General Electric, Synchronous.
1—200-kw., 250 volt, General Electric, slip ring.
1—100-kw., 250-V., Synchronous.
1— 75-kw., 125-V., Crocker-Wheeler, Synchronous.
2—50 KW, Westinghouse, squirrel cage, 4000 volt Motor.
1— 50-kw., 125-V., G.E., Sq. Cage.
1— 50-kw., 250-V., G.E., Sq. Cage.
1— 35-kw., 125/250-V., General Electric, Sq. Cage.
2— 35-kw., 125 volt, Electric Machy., squirrel cage.
2— 30-kw., 32 volt, ball bearing, squirrel cage.

**TURBINES**

3—1000-kw., 2300 volt, condensing.
1—500-kw., General Electric, 3 phase, 60 cycle, 480 volt bleeder.
1—300-kw., 3 phase, 60 cycle, 220 volt, General Electric, condensing.
1—250-kw., Westinghouse, 3 phase, 60 cycle, non-condensing
1—200-kw., General Electric, condensing.
2—150-kw., Westinghouse, 125/250 v., non-condens.

**TRANSFORMERS**

1—15,000-kva., Pittsburgh, 3 phase, 26,000/4150 v.
3—400-kva., Moloney, 13,200-220/440 volts.
4—300-kva., Pittsburgh, 4600/115/230 volts.
4—200-kva., Pittsburgh, 7800/220/110 volts.
3—200-kva., G.E., 4150-230/460 volts.
2—200-kva., General Electric, 2200/220/440 volts.
3—150-kva., Pittsburgh, 6600/440 volts.
3—150-kva., General Electric, 33,000/2300 volts.
18—150-kva., G.E., 3 phase, 4150-120/208 v.
6—100-kva., Wagner, 2200/220-110 volts.
3—75-kva., Pittsburgh, 2400/120 volts.
2—50-kva., General Electric, 2200/220/110 volts.
2—50-kva., Kuhlman, 2200/110-220 volts.
3—37½ kva., General Electric, 2400/240/120 V.
3—25-kva., Paranol cooled, 2200/220/110 volts.
3—25-kva., Westinghouse, 440/220-220/110 volts.

**MOTORS—3 PHASE, 60 CYCLE**

| No. | H.P. | R.P.M. | Volts | Type |
|---|---|---|---|---|
| 1 | 720 | 360 | 440 | G.E. Syn. |
| 1 | 500 | 450 | 2300/4000 | G.E. Sl. Rg. |
| 1 | 400 | 514 | 440 | West. Sl. Rg. |
| 1 | 350 | 300 | 440 | G.E. Sl. Rg. |
| 1 | 350 | 100 | 220 | G.E. Syn. |
| 2 | 335 | 600 | 2200 | G.E. Syn. |
| 1 | 300 | 450 | 440 | El. Machy., Syn. |
| 1 | 250 | 450 | 440 | G.E. Sl. Rg. |

**VARIABLE SPEED 230 VOLT MOTORS**

| H.P. | R.P.M. | Type |
|---|---|---|
| 1—150 | 300/900 | Westinghouse |
| 90 | 470/940 | G.E. |
| 75 | 235/950 | Burke |
| 35 | 500/1500 | G.E. |
| 30 | 600/1200 | West. |
| 25 | 300/1200 | G.E. |
| 4— 20 | 400/1200 | G.E. |
| 3— 15 | 300/1200 | G.E. |

**ENGINE SETS**

13x15 Skinner Uniflow, 150/300 RPM, engine only.
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| 6 | 1000 | G.E. | 1 | HKDD 13800-2300 |
| 1 | 300 | Whse. | 3/2 | SK 2300-2300 |
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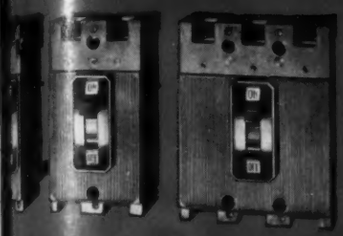
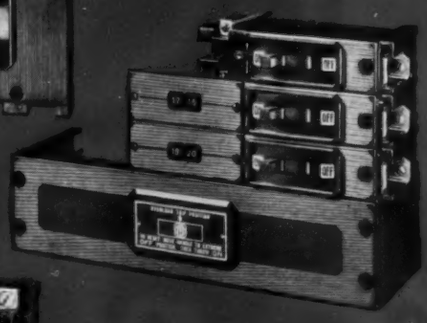
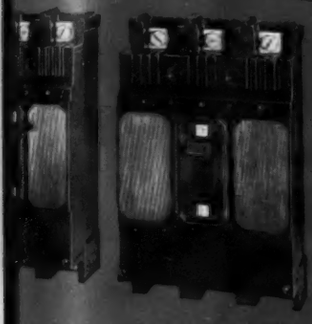


PANELBOARD MOUNTING (at left) One, two and three pole circuit breakers available with current-carrying ratings of 10 to 50 amperes.



...stration (at right) ...w how PANELBOARD ...NTING units fit to-...er to produce neat ap-...ance without waste of ...



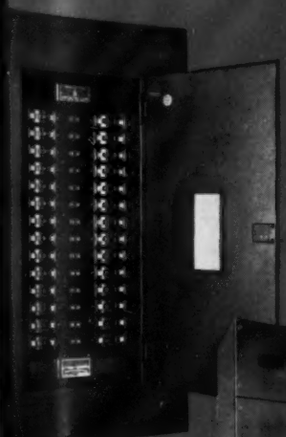
Shown at left are two and three pole GENERAL PURPOSE TYPE circuit breakers. These are 50-ampere frames. 100, 225 and 600-ampere frames are also available.

...ght is an example of the 225-ampere frame ...ERAL PURPOSE TYPE.

...Type ET devices have ...rupting ratings of 10,000 ...res. Illustrated at right ...Type ET-20 which has ...rupting rating of 20,000 ...res.

...is a 28-circuit LIGHTING PANEL with PANEL-...RD MOUNTING Type ET circuit breakers for ...00 volt a-c service.

Type ET circuit breaker, above, mounted in a sheet-steel individual enclosure.



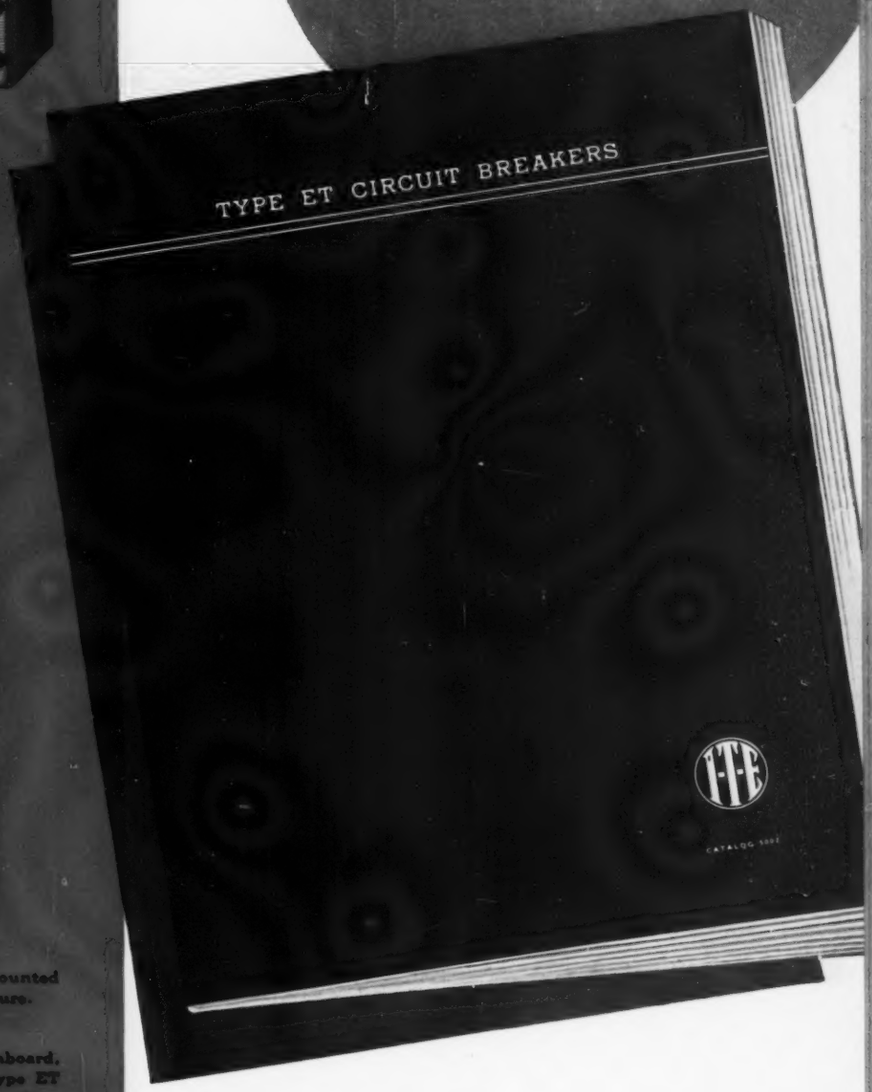
Steel enclosed dead-front switchboard, shown below, with seventeen Type ET circuit breakers and provision for three future additions.

# 40 PAGES

ENTIRELY ON

# THERMAL CIRCUIT BREAKERS

(ITELITES—TYPE ET)




**Text, photographs, diagrams and charts in this new book were assembled to provide a thorough description—a reference book and a guide to proper selection.**

**A copy will be mailed to anyone responsible for electrical apparatus, with the single reservation that the request be made on company stationery. Ask for Catalog 5002.**

## T·E CIRCUIT BREAKER CO., PHILADELPHIA, PA

*Representatives in Principal Cities*

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